DOCUMENT RESUME

ED 206 468 SE 035 509

AUTHOR Hopson, Dan; And Others
TITLE Glacial and Intertidal Ecology: A Study Guide for the Third Grade. Alaska Sea Week Curriculum Series. Draft.
INSTITUTION Alaska Univ., Fairbanks. Alaska Sea Grant Program.
SPONS AGENCY National Oceanic and Atmospheric Administration (DOC), Rockville, Md. National Sea Grant Program.
PUB DATE Jun 80
GRANT NOAA-NA79AA-D-00138
NOTE 103p.; For related documents, see SE 035 506-512. Contains occasional light and broken type.

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Earth Science; *Ecology; Elementary Education; *Elementary School Science; *Environmental Education; *Geology; Grade 3; *Marine Biology; Oceanography; Outdoor Education; Reading Skills; *Science Education
IDENTIFIERS *Coastal Zones

ABSTRACT

Two marine science units comprise this manual for teachers of elementary school students. Unit 1, "Shore Communities," involves mapping exercises and other investigations of the ecology of the intertidal zone. Unit 2, "The Glacier," focuses on glacial geology and the relationship of glaciers to the marine environment. Each unit contains several field and classroom activities, and a list of references is provided. Also included are tips for conducting field trips and a set of student worksheets which stress reading skills and vocabulary. (WB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED206468

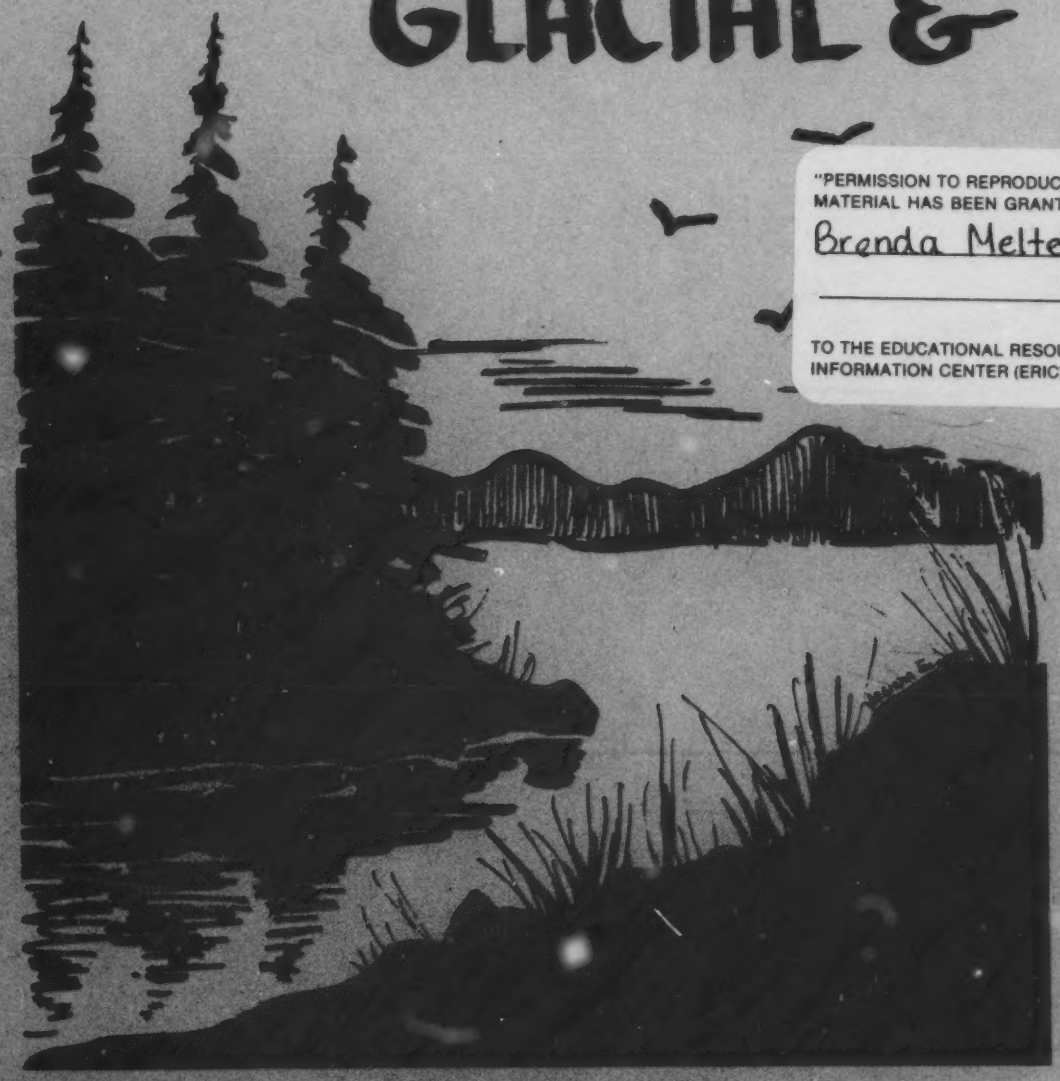
Alaska Sea Grant Program

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

AUG 1981
ERIC/CRESS
RECEIVED

ALASKA SEA WEEK CURRICULUM SERIES
THIRD GRADE

GLACIAL &



"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Brenda Melteff
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

INTERTIDAL ECOLOGY

UNIVERSITY OF ALASKA

SE 035 509

DRAFT

GLACIAL AND INTERTIDAL ECOLOGY

A Study Guide for the Third Grade

The materials in this section were originally written by:
Dan Hopson
Kristi Kantola
Pat Thrasher

Supporting materials developed by:
Juneau teachers and the South East Regional Resource Center

Edited by:
Jill Thayer
Alaska Sea Grant Program, University of Alaska

ALASKA SEA WEEK CURRICULUM SERIES

Field-test edition March 1980
First reprint June 1980

ACKNOWLEDGEMENTS

Sea Week began in the early 1970's in Juneau, Alaska. Under the leadership of Mary Lou King, parents, teachers and agency personnel started taking elementary school students down to the sea every spring. Soon, Sea Week was an annual event with some of the junior high and high school students assisting the younger pupils on their field trips to beaches, wetlands, forests and glaciers. In 1978, a K-6 Sea Week curriculum was written with the assistance of Juneau teachers, scientists, fishermen, parents, and government employees - a true community effort. In 1979, the Southeast Regional Resource Center revised the material, adding worksheets and graphics and reworking certain activities. In 1980, endorsed as "The Year of the Coast" by President Carter, it seems very fitting that the Alaska Sea Grant Program is initiating a program to spread Sea Week statewide.

This first statewide edition is a product of Juneau - its people and environment. We would like to express our deep appreciation to the many foresighted people who contributed to Sea Week and especially to all the students who are the reason and impetus behind its success. Special thanks to Mary Lou King, Nancy Barr, Janie Cesar, Carol Koski, Dick and Betty Marriot, Virginia Eggert, Claudia Kelsey, Kathy Hanna, James G. King, Lynn Szepanski, Karen Gunstrom, Mary Beth Parsons, Dan Hopson, Kristi Kantola, Pat Thrasher, Tamara Smid, Judy Maier, Jerry Hard, Marty Early, Jan Conner, Mark Hansen, the Alaska Department of Fish and Game, the Alaska Coastal Management Program, the United States Forest Service, the Alaska Department of Environmental Conservation, the United States Fish and Wildlife Service, and the South East Regional Resource Center.

Revision and publication of the Alaska Sea Week Curriculum Series is sponsored by the Alaska Sea Grant Program, cooperatively supported by NOAA, National Sea Grant College Program, U.S. Dept. of Commerce, under grant number NA79AA-D-00138, and by the University of Alaska with funds appropriated by the State of Alaska.

This reprinting is supported in part by Federal Coastal Zone Management Program Development funds (P.L. 92-583, Sec. 306) granted to the State of Alaska by the Office of Coastal Zone Management, National Oceanographic and Atmospheric Administration, U.S. Dept. of Commerce.

TABLE OF CONTENTS

		Page
Preface		
Introduction		
Zonation		2
Algae		10
Habitat		20
Reproduction and Settlement		25
The Mussel Community		29
Landscape Carved By Glaciers		36
Worksheets		57
Appendix I	Steps to Organizing a Sea Week in Your Community	A-1
Appendix II	Suggested Field Trips	A-2
Appendix III	What To Do On The Bus	A-3
Appendix IV	Conservation	A-4
Appendix V	Check List	A-6
Appendix VI	Suggested On-site Organization	A-8
Appendix VII	Look at the Beach	A-9
Appendix VIII	Tides	A-13
Appendix IX	Bibliography of Helpful References	A-14
Evaluation Sheet		

PREFACE

The Alaska Sea Week Curriculum Series (K-6) emphasizes one or more aspects of the marine environment at each grade level. Kindergarten materials, for instance, are intended to introduce students to the exciting and curious world of the sea and shore. At the other end of the series, materials for sixth graders stress man's interactions with the marine environment. While the subject matter at each grade level is unique, as a whole the grade level guides will yield a broad understanding of the marine environment and its importance to Alaskans.

The purpose of this curriculum series is to help the teacher in interpreting the marine environment for elementary school students. However, what is included here is just a place to begin. As you read the following materials, you will find factual information about many aspects of the marine environment, and suggestions for presenting these concepts to students through multi-disciplinary activities both in the classroom and at field sites. Materials are organized into units, each covering a single idea or subject. From these you, the teacher, may select the units and activities which are best suited to your class, community and resources.

"Sea Week" originated in Juneau, and these curriculum materials are most applicable to southeast and southcentral Alaska. However, the Alaska Sea Grant Program has funded a three year pilot project to expand Juneau's successful program statewide. As Sea Week is piloted in 14 communities around the state, the Curriculum Series will be expanded to meet the needs of western, interior, and northern Alaska.

Send us your comments and suggestions. The strength of the final edition will depend not only on those of us staffing the project - but on you - your ideas and comments. After you've tried some of these activities - fill out and send in the evaluation sheet at the back of this book. Thanks so much!

Jill Thayer/Belle Mickelson, Coordinators
Mary Lou King/Nancy Barr, Consultants
Alaska Sea Grant Program
University of Alaska, Fairbanks, AK 99701
479-7631/7086

INTRODUCTION

Alaska has more than 33,000 miles of shoreline; the earth's circumference is only about 25,000 miles. Much of Alaska's complex and intricate shoreline is accounted for by the bays, inlets, headlands, islands of Southeast Alaska. Here, in Alaskan communities large and small we live in close contact with the marine world. Some of us make our livings by fishing or working for the Coast Guard, the State's marine transportation system, or marine shipping companies. Most of us spend at least some of our time sport fishing, digging clams, beachcombing, or just gazing out at the incredible scenery of snowcapped mountains and everchanging inland waters.

The dynamic marine environment of which we are a part is our heritage, our trust. It is only fitting that our children know that world intimately so that they can grow up in an understanding of its complexities, it subleties, its importance. This is of particular urgency now that Alaska is facing increasing pressures to make decisions that will effect the use of her lands and seas for generations to come. We, and our children, must have a part in the decision making processes and the more knowledgeable we are, the more effective our participation will be.

Teaching children about the world in which they live is important and perhaps it has never been more important than it is in Alaska today. Teaching facts and concepts about the marine world is important but perhaps most important of all is the teaching of attitudes. It is hoped that through the study of marine life, students may gain the following:

1. An increased interest in their environment.

2. A greater awareness, appreciation, respect for the natural world that is so close about them here in Alaska.

3. The sheer delight, pleasure, happiness that can come from observing and understanding nature close up.

4. A sensitivity to the relationship between themselves and their environment.

If that can be accomplished, all our lives will be better because of it....

INTRODUCTION - THIRD GRADE

If the Alaskan marine curriculum guide is in use in your school, by the time pupils reach third grade they have studied marine life for parts of three years. Their background will include the following.

kindergarten - an introduction to the sea, its life forms, and its importance to us

first grade - a study of the major kinds of animals that live on northern beaches

second grade - an intensive study of one group of marine animals - the mollusks, or snails, clams, and related creatures

The third grade materials in this series are presented in two parts -

1) an analytic look at some aspect of marine shore communities,
2) introduction to glaciers and glaciology explaining how these forces shaped the Alaskan landscape.

Each unit contains many activities. The materials in Unit 1 - The Shore Communities - are based upon what students already know and will lead them one step further toward an understanding of the complexities of marine life. Unit 2 - The Glacier - focuses on glaciers themselves but stresses their relationship to the marine environment.

Whether you choose to use both of the units or only one, you will be building upon and expanding the students' information about the sea, including its relationship as a part of the whole coastal environment in Alaska.

If you have not used this curriculum series before, you may want to prepare your students by using activities from the the books for the lower grade levels.

THE SHORE COMMUNITIES

OBJECTIVE

To understand that complex interrelationships exist among plants and animals of the intertidal zone.

To understand that each intertidal organism is uniquely and closely tied to its environment.

To develop some elemental skills and understanding of the methods of scientific investigation.

Teacher Background

In any environment in which plants and animals can grow and survive - be it back yard, forest, desert, or ocean floor - all forms of life that exist in that environment are in some way interrelated to the survival of the community as a whole. Almost inevitably, the interrelationships between individual species of plants and animals and of these organisms to surroundings is complex and at first, perhaps, hard to comprehend. A bit of careful study and thoughtful observations, however, and some of the mysteries may begin to be cleared up.

In this study of shore communities, students will be introduced to several concepts - the idea of zonation, the concept of habitat, the role of algae in a shore community, the importance of reproduction and successful settling of tiny, new organisms, and the composition of a small community. Taken as a whole, a study of these ideas will give students a solid appreciation of the complexities involved in one very important, close at hand, segment of the natural world. Hopefully, such a study would show them new ways to see things, encourage them to examine their world closely, and provide them with the mental tools necessary to look with equal care at the other parts of the sea and land that are their heritage.

It is hoped that before beginning this study with your students, you as a teacher will read the entire unit over carefully so that you will have the best possible grasp of its overall direction and purpose. This will enable you to better adapt particular ideas or activities to your students and to the specific piece of Alaskan shore which they will study.

Unit 1. ZONATION

Objective:

To learn that each intertidal organism can live only in a particular vertical part of the intertidal zone.

To consider some of the factors that influence vertical zonation of intertidal plants and animals.

To learn a method for studying the differences in vertical zonation.

Teacher Background

If the tide is low and we look across the general beach landscape, it soon becomes apparent that there are several horizontal bands or zones, each distinguished by a particular color or texture. The special characteristics of each of these areas come from the plants or animals that predominate in that specific part of the beach.

Although each beach has its own unique characteristics, in general there is a similarity to beaches in any given geographic area - if the beaches have the same kind of surface. Steep, rocky shores of Southeast Alaska, for example, generally have the same kinds of zones. Typically, the upper band of such a beach will look black, a color derived from the black, encrusting lichen that cover the rocks that typify the upper, or splash, zone. Moving down the rocky shore toward the water's edge, we would find a zone of barnacles, a narrow band of yellow-brown rockweed called Fucus distichus, a prominent zone of the dark blue mussels (Mytilus edulis), and a low zone where a mixture of red and brown algae predominates. If the beach surface is primarily small boulders, gravel, or sand instead of larger boulders and bedrock, the zones are usually less obvious and less dramatic.

After we recognize the fact that different intertidal organisms do tend to live at differing vertical levels of the beach, the next question to be asked is - why? Several factors influence exactly where on a beach any particular plant or animal can best thrive:

-where the food it needs is available in best supply
-where it will find the light intensity to which it is best suited
-how great a resistance it has to drying out
-how much exposure to fresh water it can tolerate
-how adaptable it is to living in surf conditions
-how well it can compete with other plants or animals

For every plant or animal on the beach, these factors are different and the combination of all the factors as they relate to a specific plant or animal will determine where that organism will be found. Looking at only a part of the total complexity we would find that because rockweed needs more light than most other kinds of brown algae but that it is are resistant to drying, it can live higher up the beach and use a space where other algae cannot grow. Some barnacles are very resistant to drying and can live high up on the beach; they could also successfully live lower on the beach but there they are crowded out by mussels. As another example, some kinds or green algae are quite tolerant of freshwater and can grow in areas where few other marine species can survive.

Slow or sudden changes in the geology of an area also effect zonation. Land masses in Southeast Alaska are rising very gradually as glaciers and icecaps from the last ice age disappear. Thus the intertidal zone must shift gradually downward over the centuries. Evidence of this can be found at road cuts above the shores of Southeast Alaska; there, very old shell material can be found - high above the level of present beaches. Sudden geological change occured during the 1964 earthquake when some beaches around Prince William Sound suddenly rose more than 30 feet. Intertidal organisms in these areas are still adjusting to the change 15 years later and old barnacle shells can now be found on rocks among alders, well above the highest tides.

ACTIVITY 1: Recognizing and Mapping Intertidal Zones

Objective:

To recognize the five major zones on a rocky, Alaskan shore.

Materials:

slide series illustrating five zones or other illustrative material

PROCEDURE

At the core of any study of beach zonation is the time spent at the beach looking closely at zonation. Before going to the shore, however, students should be well prepared for what they will look for and what they will do when they arrive at the shore.

Therefore, begin this unit with a class discussion about zonation. (Be sure to include an appropriate movie if one is available.) Discuss with students the idea that for variety of reasons, some plants and animals that live in

salt water can stand being out of the water longer than others. Encourage students to think of what some of these reasons might be; lead them to a discussion of the factors listed here -

availability of food
tolerance to light
resistance to drying
tolerance to fresh water
ability to withstand surf

By drawing on the chalk board or by using an illustration that you have prepared ahead of time from the suggestions included with these materials, point out that on rocky Alaskan shores there are five distinct zones and that these zones are closely connected with the factors you have discussed and have decided might limit where a plant or animal can live.

Using the slide series and the wall illustration, discuss the five major zones which are marked by the presence of -

1 - black lichens
2 - barnacles
3 - rockweed
4 - mussels
5 - red and brown algae

Students will probably recognize mussels, barnacles, and perhaps rockweed. Explain to students that the presence of each of these five kind of organisms marks a particular area or kind of community on the beach - one that is made up of plants and animals with particular kinds of tolerances to how long they can be out of salt water. Obviously, the red and brown algae and the animals that live with them have the least tolerance to air while black lichens need only to be exposed to salty air and occasionally to the salt water itself.

At the Beach

ACTIVITY 2. CALCULATING EXPOSURE TIME OF INTERTIDAL ZONES

Objective:
To determine how long organisims in each of the five intertidal zones can tolerate being exposed to air.

Mateirals:
tide book, watch

PROCEDURE

Begin this activity at the time indicated for low tide, or, if this is not possible, begin as the tide is flooding and make what notations you can.

Have students check the beach to decide for themselves where each of the five zones you have discussed is located. You may want to mark the top and bottom of each zone in some way - with rock piles, with stakes to which bright tape is attached. As the level of the tide rises, record the time when it reaches each of the markers. Your record may look something like this:

low tide	10:45
top of red and brown algae zone	11:53
top of mussel zone	12:50
top of rockweed zone	1:45
top of barnacle zone	2:40
top of black lichen zone	-

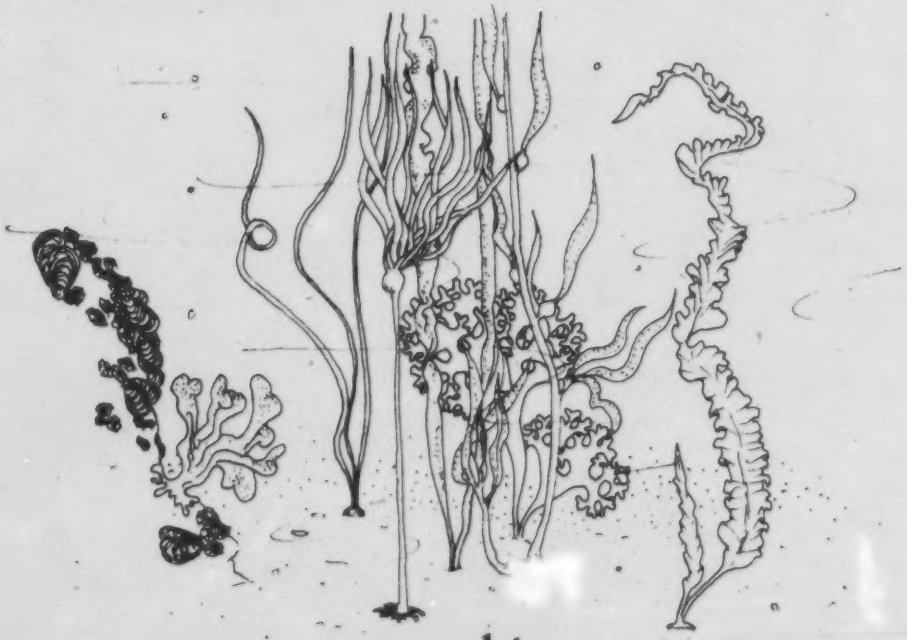
Sit down with students and let them figure out how you would find out how long the barnacle can stand being out of water, how long the mussels can, etc. To make this calculation for the mussel zone, for example, subtract the time of low tide from the time it reaches the top of each zone:

ie. 12:50 (mussels)
- 10:45
2 hrs.-5 minutes

Multiply by 2 and you will know the total length of time the mussel zone is exposed to the air on that tidal cycle.

CHART - TIDAL EXPOSURE

	Time tide at top of zone	Time of low tide			Total exposure of zone
Black Lichen			X2	=	
Barnacle			X2	=	
Rockweed			X2	=	
Mussel			X2	=	
Red/Brown Algae			X2	=	



14

ACTIVITY 3. TRANSECT STUDIES

Objective:

To recognize that different communities of plants and animals may be found at differing beach levels.

Teacher Background

Scientists often "may" a beach by using transect lines. These lines are a way of taking random cross-sections of beach life in a particular area. The sampling technique involves careful counting of all organisms, plant and animal, in standard-sized squares placed at regular intervals on a transect line. Since the line itself is placed at random across the study area, scientists can then use statistical analysis to obtain rough estimates of total populations present and an idea of which organisms are dominant in each zone. The method here will not be so rigorous as to include statistical analysis, but...(by trying these, techniques, etc...) By trying these techniques, students will begin to understand some of the techniques of scientific investigation and will discover a new way of looking at a familiar environment.

If done carefully, this activity will take perhaps an hour. During a field trip to the shore, it may be one of several activities planned.

Materials:

review materials (slides, other illustrations) of common intertidal plants and animals - optional
adhesive tape
a 100 foot lenghth of 1/4 inch line
coathangers - 1 for every 2 students
meter stick
pencils and paper or notebooks

Discuss with students the idea and reason for doing transect studies on a beach. Prepare students for involvement in such an activity themselves by reviewing with them the common intertidal plants and animals of the local area. This may be done using slides, blackboard drawings, or any other kinds of illustrations. Teachers in your school from K-2 should be able to help you with review materials if they have been using the Sea Week materials with their students.

Involve students in preparation of materials for the sampling. Using a meter stick, mark the rope at 1 meter intervals. At each mark, wrap an adhesive tape tag. Number the tags in consecutive order. Divide students into teams of two, or let them choose partners. Give each team a coat hanger and have them bend it into a square. Now you are ready to go to the shore.

At low tide, the site to be studied, select a distinctively zoned beach area and lay the rope out from high to low tide marks down the beach. Keep the line as straight as possible, angling it down the beach if necessary. Look at the line and select an appropriate 1, 2, or 3 meter interval at which to space out the counting squares to adequately cover each zone. Students may then pick numbers and place their counting squares next to the line with the adhesive tag at the center of the side of the square touching the line.

To do their sampling, each team of two must make a rough count of at least the dominant plants and animals in their square and record these numbers. Usually it works best for one person to count and the other to record; students may want to trade off on these jobs so that each of them gets a chance at both tasks. It may be helpful, when reviewing the beach organisms BEFORE you go to the shore, to include a discussion of how to set up their data records. A simple record sheet would look as follows:

SQUARE NO. 3

Plant or Animal	Number
mussel	10
worm	3
small snail	21

Encourage each group of two to be as specific as possible in their listing of organisms. If there are two distinct kinds of snails, for example, they may want to list them as snail #1 and snail #2. Algae should be listed descriptively - for instance, small red algae, thin green algae - and students may actually count the number of plants in their square or they may estimate how much of the square the algae cover, as 1/2 or 3/4 of square.

In order to give all students a chance to be involved in the study, you may need to use all the possible plot marks on the line or you may need to set up two study lines - perhaps in slightly differing areas so that you can compare the results of the plots on the two lines later.

When you return to the classroom, construct a large chart and let students enter their own data on it. The chart may look as follows:

Plant or Animal / Plot Number	Red Algae	Green Algae	Rockweed	Seastar	Seaurchin	Worms	Mussels	Snails	ETC.
1.									
2.									
3.									
4.									

When the chart has been filled in by the students, involve the class in an analysis of what it shows. What kinds of plants and animals occur low on the shore? Which ones are high? Do any occur in every plot? Which are the most widespread? Encourage students to think about why some of the plants or animals occur where they do? What kinds of adaptations do they have for living out of water as long as they do? Why might particular organisms be able to stay out of the water longer than others?

ACTIVITY 4. TIDE RANGES

Objective:

To realize that tidal ranges differ around the world, and even within Alaska.

Materials:

World map or map of Alaska
reference work that gives tide ranges

PROCEDURE

Have all students or a group of class members, select particular places on the map and have them look up the tidal range for these places. Mark the figures on the map.

This activity involves the skill of map reading and interpreting tide tables. After the work is done, draw the attention of the class to the fact that tidal size can vary a great deal from place to place.

If you have used a map of Alaska for marking tidal ranges, be sure to include inside and outside communities in Southeast Alaska, Cook Inlet and the Aleutian Islands. Be sure to include your own community!!

Unit 2. ALGAE

Objectives:

- -To learn the main categories of intertidal algae and to learn to recognize them.
- -To learn to recognize a few important species of local algae.
- -To understand some of the importance and the uses of algae.
- -To learn how certain algae can tolerate being out of the water for several hours.
- -To learn that different kinds of algae have different densities - and to learn what "density" means.

Teacher Background

Plants that live intertidally and subtidally in our marine waters belong to a special group called algae. These plants are especially adapted for living in water. Unlike the familiar, higher land plants, algae have no roots, no flowers, no seeds.

In general, algae can be divided into two categories - the small, microscopic, often drifting species, and the larger more familiar, macrophytic algae.

The tiny, microscopic species are called phytoplankton as they are adrift in the ocean. Phytoplankton species are one-celled plants, though they may form chains or other kinds of aggregations. Though very small individually, they may divide rapidly if conditions are right and thus become extremely abundant. Such abundance is termed a plankton bloom and can be seen by the naked eye as brownish or reddish matter in the water. This phytoplankton forms a base for much of the life in the ocean - on it feed only slightly larger animals called zooplankton, which are fed upon by larger animals, and so on until it can be clearly seen that fishes, invertebrates, even the sea mammals are ultimately, directly, or indirectly dependent upon these tiny plants for their survival.

Although most of the microscopic algae are drifters, some may be found on rocks and other surfaces where they are eaten by grazing invertebrates. Sometimes during the warm months when plankton blooms occur, the plankton may wash ashore where it may cover the beach surface as a brown-red slippery film.

Large forms of algae may grow intertidally or subtidally. These big, water-dwelling plants, though they may vary greatly in form, have several characteristics in common. Most of them grow on hard surfaces - rocks, shells, pilings - to which they fasten with a special structure

called a holdfast. The holdfast may be disc-shaped or may be like fingers, but in either case it functions to hold the plant to the solid surface and, unlike a root, doesn't transport nutritive materials to the plant from the soil. Macrophytes have no flowers or seed; instead they have special structures on the plant body itself which produce tiny beginnings of new plants. A number of the large forms of algae, including the common bull kelp, have round bladders that are gas-filled and which help support the plant in the water, bringing its blades nearer to the water's surface for better exposure to light.

Like all green plants, algae contain chlorophyll, the substance essential for the manufacture of plant material. The three large groups of macrophytes are defined by the kinds of chlorophyll and other color pigments they contain:

Green algae - with green pigments. Found growing in intertidal or shallow subtidal waters.

Brown algae - with green and brown pigments. Presence of brown pigment enables them to utilize a lower level of light than green algae require. Therefore they may be found deeper than the greens.

Red algae - with green and red pigments. Presence of red pigments enables them to utilize an even lower level of light. Thus red algae may live in depths greater than those where brown algae are found.

Intertidally, there are four main categories of algae:

Bluegreens - found mostly as a film on rocks or as small plants living on larger ones (epiphytes).

Greens - only a few species, but may be very abundant. Sometimes found where there is freshwater seepage.

Browns - dominant by size. Most are low intertidal and subtidal.

Reds - dominant by their variety of form and species. Mid and low intertidal as well as subtidal.

Many of these algae are perennial, dying back or being eaten in the winter, then putting out new growth in spring. Others reproduce annually, producing tiny spores that settle on particular beach areas.

ACTIVITY 1. ROCKWEED

Objective:

-To learn to recognize one common intertidal sea weed.

-To examine its growth form.

Teacher Background

Most children who have spent any time on the beach will be familiar with rockweed, even if they don't know a common or scientific name for it. Some of them may know it as pop-weed.

Rockweed, or Fucus distichus (few-cuss dis - ti -chus) is the common, yellow-brown seaweed found in the upper intertidal zone. The tips of the blades become reproductive sacs in the spring and will then pop if squeezed or stepped on. The plant grows dichotomously - that is, it always branches by twos. Counting the number of dichotomies from base to tip gives a general indication of the age of the plant, although each dichotomy does not necessarily equal one year's growth.

Materials:

-rockweed - either at the beach or brought into the classroom for examination

-magnifying glasses

PROCEDURE

If rockweed is to be used in class, collect some ahead of time, wrap it in moist paper towel and keep in refrigerator in a plastic bag for a day or two until ready to use.

If you have enough rockweed, distribute a plant to every pair or group of students - or have each student find a piece on the beach (no need to pull it loose there!). Have students examine the plant in general, noting how it feels, the shape of its holdfast, and checking to see if the tips of any blades are swollen.

This is a good plant to use for reviewing the idea of scientific names so give students the name

Fucus distichus

Remind them that scientific names are underlined (if you are doing this in the classroom and have written the name out for them) and that the first word (Fucus) is like a family name (Smith) and that the last word (distichus - which is NOT capitalized) is like the given name (Sam).

Explain that by counting the dichotomies, students will be able to tell more or less how old the plant is. As a class, discover what "dichotomy" might mean by thinking of other words that start with the prefix "di" (divide, divorce, diverge). Have each student count the number of dichotomies on the plant he or she is examining.

With magnifying glasses, look closely at the Fucus plant, paying special attention to the small bumps on the terminal swellings. These are the reproductive chambers where microscopic new plants will have their beginning.

ACTIVITY 2. RATES OF DRYING OF ALGAE

Objective:

-To discover if different kinds of algae have different tolerances to drying in air.

Teacher Background

If you have done any of the activities in Unit 1 with your class, they will probably find it interesting to test for themselves the idea that some kinds of plants are able to live longer out of water without drying than others. Like Activity 2 in Unit 1, this activity is based on a method of scientific investigation used by professionals, thus, though it is easy for students to do, it is "real science".

Materials:

-a balance scale
-aluminum foil
-healthy plants of several species of algae - perhaps collected during the class field trip and brought back to the class moist in plastic bags

PROCEDURE

If students are not familiar with the balance and how it is used to weigh materials, spend some time teaching them how to use it. For initial learning, let each student try weighing some small object of his or her choice, learning as he or she does, how to adjust the scale until it balances, then how to read the weight of the object in question.

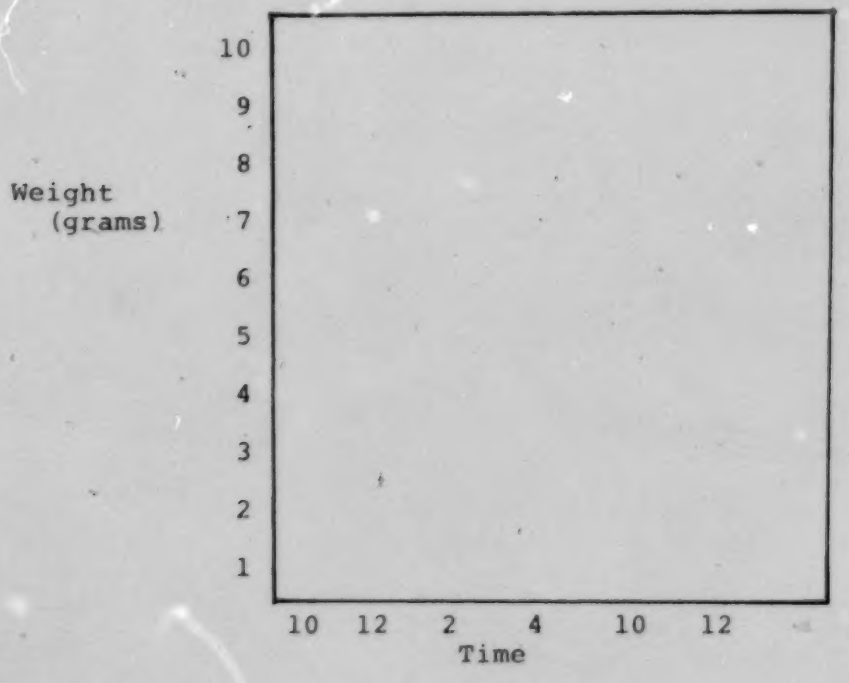
After practice with the balance (if needed) prepare an aluminum foil tray for each species of algae. (Students might divide into groups for this activity and each group might be in charge of one species.) Weigh each tray on the balance and record its weight to the nearest gram.

Remove the algae from the plastic bags and blot the plants to remove excess moisture. Place each plant on its tray and weigh it. Subtract the weight of the tray from the weight of the tray and plant to learn what the plant weighs.

Keep the plants in their trays at room temperature, uncovered, and weigh them at 2-hour intervals throughout the school day, each time remembering to subtract the tray weight.

Continue weighing plants until they are dried or their weight ceases to change. This may take several days for some species.

Make a graph of the rate at which each different algae dries out. Your graph may look something like this:



When the results have been graphed, discuss with the class what the graph means. Which seaweed dried out faster? Which dried out most slowly? According to how fast each one dried out, how high or low on the beach would you expect to find it? Do you remember from the field trip, where you found each of the kinds of algae that you dried?

ACTIVITY 3. FINDING AND COMPARING DENSITIES OF SEAWEEDS

Objectives:

- -To learn what density is.
- -To find the density of some familiar objects.
- -To find the densities of several seaweeds and to think about what their densities might mean.

Teacher Background

"Density" is probably a new term for your students, so this activity will take a little advance teaching. When you introduce the term to students, write it, say it, and explain that density means the relationship of how big something is to how much it weighs. As a good beginning exercise, divide the class into groups or working with the class as a whole, set out several objects -

styrofoam block
wood
something made of iron or steel or lead
a book
something glass - etc.

Ask the student to place the objects in order from the least dense to the most dense. When everyone understands the idea of density, you are ready to "scientifically" determine the density of several classroom objects - and of algae!

Materials:

- -small classroom objects of varying densities - let students select some!
- -samples of several species of algae - all in fresh condition, perhaps brought back from your class field trip
- -a balance
- -a liquid measuring cup marked in cubic centimeters (cc) or milliliters (ml)
- -a container big enough to hold your largest plant specimen or object

PROCEDURE

First the classroom objects -

Take the large container and ask a student to fill it carefully with water. Fill it up to a line that you have marked on it to indicate a standard water level.

Using the measuring container, measure the amount of water in the large holding container. Measure it in cc. (1 cc = 1 ml).

Take an object the density of which you want to determine and put it in the large container. Add water up to the line. Remove the object and measure how many cc of water are in the container. By subtracting your answer from the total number of cc the container would hold, you now know the volume of the object, or how much space it fills up.

Dry the object whose volume you just determined and weigh it on a balance to the nearest gram.

Figure the density of the object by dividing its weight in grams by its volume in cc. Thus something with a weight of 10 grams and a volume of 2 cc would have a density of 5 grams per cubic centimeter.

You may want to follow this procedure with several classroom objects before trying it with algae. Point out to students, that by weighing and measuring they have made a "scientific" decision about which objects are more dense than others. Now they don't need to just rely on their guess work!

Then the algae -

When students understand the procedure and understand what the results tell them have them try finding the density of several kinds of algae. Follow the same procedure as you did above, but remember to blot dry each piece of algae before weighing it.

Compare the densities of the several kinds of algae. Try to include a peice of rockweed or some other algae with floats in your testing. What kind of densities do these seaweeds have? What do the densities you found for the algae mean about how they can live in a watery environment? Compare their densities with those of the classroom objects - or of land plants.

Other Activities -

1. Science-Phytoplankton. If you have a microscope available to you, you might consider having students take a look at the other algae - the tiny,

microscopic photoplankton. To do this, pull a fine mesh net through the water and save the green or brown "scum" that you collect. Wash this off the net carefully with sea water and collect in a container with sea water. If you plan to use the sample the same day, refrigerate it until ready to use. To preserve the sample for later use, add a small amount of 4-5% formalin solution to the container. Look at a few drops of the water under the microscope. You may see both tiny plants and larger animals, the latter usually very active, if the sample is fresh, and equipped with several appendages.

2. Art. Small algae can be easily dried and can then be used in any number of art projects. For this purpose select small pieces of algae that are fine rather than thick. Rockweed, for example, will not dry well, but some of the small red algae will. Collect only those pieces which you expect to be able to use. Then you will need -

    a pan as large as the algae you have gathered
    heavy paper
    water

Fill the pan with water and float the sea weed on it, manipulating with your fingers to it spreads out well. Slip the piece of paper under the algae and gently lift it up and out of the water. Place the paper with the algae between blotters or other absorbant paper. Dry for several days. The algae should adhere to the paper; but if it doesn't use glue sparingly to hold it in place.

Algae dried by this method may be used in many ways. They may be used on notepaper, framed for wall decorations, protected under clear contact for bookmarks.

3. Food. Seaweeds have traditionally been an important food for Alaska natives and for many other peoples around the world. As is true of eating any wild foods, knowing which seaweeds are edible and how they are best prepared requires having a good tutor or taking long and careful hours of research or expermentation.

On your local beaches you will probably find several edible species which you may want to try with your class. Of these, the large, brown algae called bull kelp, or Nereocystis Lutkeana, one of

the easiest to identify. Bull kelp is most frequently used to make pickles - and one recipe for this may be found in the section on algae in the kindergarten guide of this series.

The very thin, green blade of the sea lettuce may be eaten directly from the beach and is sometimes used as a salad green.

Several species of red algae are traditionally used by Alaska natives but finding and identifying these is best done with the help of someone who already knows the plants and their uses.

If you are hesitant to introduce algae as food to your students, consider seeking out someone in your community who uses these plants for food and asking that person to share his or her knowledge with the class.

An excellent and interesting book which includes both identification of numerous species and many interesting recipes using seaweeds is:

The Seavegetable Book by Judith Cooper Madlener, publised by Clarkson N. Potter, Inc., N.Y. 288 pp. paperback

4. Science -identification. If students are interested in learning the names of seaweeds, they must start by recognizing that many of them do not have common names. In studying the seaweeds, they might begin by learning the three common plants that do have names -

bull kelp
rockweed,
sea lettuce.

They need also to recognize early that deciding if an algae is red, brown, or green is a first step in its identification.

For help in identifying local algae, try to find someone locally who knows the plants well or consider using one of the following references:

Scagel, R.F. Guide to Common Seaweeds of British Columbia. A paper back book and part of the fine identification series put out by the British Columbia Provincial Musem. Covers most of the common seaweeds found in Southeast Alaska.

Madlener, J.C. The Seavegetable Book. Covers some of the species common in Alaska and for the species it does include it has excellent information and direction for use as food.

Abbott, I.A. and G.J. Hollenberg. Marine Algae of California. A large scientific volume. Many of the species of algae that grow along the California coast also grow in northern waters.

5. Observation. When you are at the shore with your students encourage them to be aware of algae as a part of the beach community. Suggest that they think about how different kinds of algae differ from each other in appearance. Have them feel several kinds - can they describe the differences? Can they describe subtle differences in color, texture? Are they aware of where each different kind grows, what small animals live on or under it, how large it is, how it looks as a small plant? Being aware of such qualities is part of being a keen observor - and a part of living at its richest!

Unit 3. HABITAT

Objectives:

- -To become aware of different kinds of beach habitat.
- -To understand that different kinds of shore animals prefer different kinds of habitat.

Teacher Background

Every plant and animal has a particular habitat or living situation for which it is most suited. Deer, for example, live in forests, beavers live in swamps, whales live in open oceans, and earthworms live in soil. The marine intertidal area offers a great variety of small specialized habitats, each of which is used by one or more species of animal or algae. Some species - such as the dark lichens growing on rocks in the "splash zone" high on the beach or tube worms living in mud - have very narrowly restricted habitats, but others - like barnacles or the small snails called periwinkles -range widely over several habitat types.

Several factors go into defining a particular habitat. Here are some of them:

beach type - bedrock
large or small boulders
sand
mud
gravel
Each of these is home to particular kinds of plants and animals.

time of exposure to air at low tide - This is involved in determining how high or low an organism can live on the shore. (see unit on zonation)

degree of shelter - Areas under rocks, under ledges, in cracks, beneath algae, etc., may afford protection from predators, from excessive drying out, from wave impact, high or low temperatures or abrasion from drift material. Some organisms prefer such places, but others - like barnacles or mussels - live in open places because their soft bodies are well-protected by hard outer shells and because they need open, circulating water so they can feed.

Tide pools are specialized habitats that enable low intertidal forms to live higher on the beach - and thus perhaps escape some of their usual predators.

ACTIVITY 1. HABITATS AND TEMPERATURES

Objective:

- -To determine if there is a difference in temperatures among various shore habitats.

Materials:

-thermometer
-paper and pencil for recording

PROCEDURE

This is a shore side activity but it is best carried out with an advance introduction to the idea of habitat. Therefore, begin with a group discussion of the idea of habitat - you might want to suggest that students look through periodicals and find pictures of as many different habitats as they can. Have each student explain one habitat to the rest of the group.

When students have a grasp of the idea of habitat, introduce them to the idea that there are many different kinds of habitats on the beach. See how many different kinds of beach habitats they can think of - write them on the board, perhaps have each child draw a picture of what he or she imagines ONE beach habitat to look like.

When the class goes to the shore, be sure you have outlined with them ahead of time what they will do. Perhaps you will want to divide them into groups and entrust one thermometer to each group - preferably with an adult in charge, or you may want to assign this activity to only one group out of the whole class. Be sure to give students practice in reading a thermometer and explain to them the kind of information it gives them! In either case, students should be armed with pencil and paper that looks like the following:

HABITAT	TEMPERATURE

With adult supervision, let students identify various habitat types, then measure the temperature of each - perhaps noting if it is an air temperature or a water temperature.

Later students may want to make a chart listing habitats in order from coolest to warmest. They may want to compare their temperatures with others - human body temperature,
room temperature
freezing point
boiling point - etc.

ACTIVITY 2. BEACH HABITATS AND THEIR INHABITANTS

Objective:

To learn what shore animals live in what habitats

Materials:

pencils
clipboards
charts

METHOD

Prepare a chart such as the one that follows - you may want to develop it with student help, encouraging students to anticipate what they might find at the beach before going there.

During class time at the shore, let students work in groups to identify a variety of habitats and carefully examine them to see who lives there. Their findings should be recorded on the charts at the sites - and students should not hesitate to add additional habitats - perhaps man made ones such as discarded bottles, rubber tires, or wharf pilings - and inhabitants to their lists!

	Rock Face	Tide Pool	On Boulder	In Crack	In Sand	In Mud	Under Rock	On or Under Algae	On or Under Animal	On Pebbles	In Gravel	Other ?
Sea Cucumber												
Hermit Crab												
Mussel												
Barnacle												
Starfish												
Urchin												
Anemone												
Worm												
Clam												
Algae												
(Add Others)												

Follow-up the shore time with class analysis of the charts. Where would students now expect that they would find barnacles? Where would they go to look for worms? etc. What can they say about the kind of habitat each animal prefers?

ACTIVITY 3. HABITAT PREFERENCE EXPERIMENT

Objective:

-To experimentally determine which of two habitats a particular shore animal prefers.

Materials:

-rectangular pan
-sea water
-a dozen or so individuals of model shore species such as amphipods (beach hoppers), isopods (pill bugs), snails or hermit crabs
-material to make a habitat - rocks or sand or mud, etc.

METHOD

Collect a dozen or so individuals of one kind and bring them back to the class room. (you may want to do this collecting during your field trip and conduct the experiment in the classroom as a follow-up to the shore experience.) Keep the animals in a cool place - perhaps wrapped in salt-water-moisted towels in a refrigerator - until you are ready to set up the experiment.

When you and the class are ready, fill the pan with sea water and arrange a habitat at either end. Some sets of habitats you may want to set up are the following:

algae vs small rocks
sand vs rocks
gravel vs algae
dry vs wet
light vs dark

Place the animal in the center of the pan and set the pan in a cool place, perhaps just outside the classroom door in a shady spot. Watch, or check the pan at short intervals, to see which habitat the animals prefer. You may want to try one kind of animal with several choices or try several kinds of animals with the same or differing choices.

If you did activity 2 above with the class at the shore, you might compare what you observed at the beach with what you learned from the classroom experiment.

ACTIVITY 4. UNDER ROCK HABITAT

Objective:

-To explore in detail one particular shore habitat.

METHOD

If students have thought about habitats in general and/or have explored several habitats at the shore by doing Activity 2, they are ready to look very carefully at one particular habitat at the beach. A good one to pick is the area under medium-sized-rocks-at-low-tide-level, because it can offer a range of fascinating inhabitants.

Choose a likely spot in the low intertidal zone and carefully turn over a rock or two. You may find brittle stars, sea cucumbers, clams, blennies, and/or worms, including perhaps a harmless, bright orange ones that may stretch to three feet long or more! Be sure to remind children to turn the rock back over and put it in place again after they have explored this small habitat. The animals that live under the rock were there because they could survive in that habitat; by failing to replace the rock, you would be destroying their small habitat.

ACTIVITY 5. INTERTIDAL ROLE-PLAYING

Objective:

-For the student to imagine he or she is a particular kind of shore animal and to think about the habitat requirements of that animal.

Teacher notes -

Beach observations may be reinforced by having the students act out various kinds of plants and animals that would occur in a given habitat. Perhaps you would want to use this activity as a summary of what students have learned about the habitat preferences of beach critters.

METHOD

This activity could be carried out in many ways. As just one suggestion, consider making up a set of slips of paper, each with the name of a common beach plant or animal on it. Have each student draw the plant or animal on the slips of paper, think about where he would go in the classroom to act out where that animal or plant would live on the beach. Then at a signal, each student could move to his or her chosen place. For example, under rock species might congregate under a table, crevice dwellers between bookcases, etc.

Unit 4. Reproduction and Settlement

Objectives:

- -To learn that for many marine organisms, reproduction is triggered by seasonal change.
- -To learn to look for and recognize some common shore animals as they spawn or settle out as young.

Teacher Background

Spring is a time of awakening, of renewal. On land, birds build nests and lay their eggs, seeds germinate, and trees that were bare all winter leaf out again. At the edge of the sea, the same kinds of processes occur, for spring is a time of growth and of new generations there, too.

Triggered by increasing hours of daylight and higher temperatures, beach animals and plants hurry to reproduce their kind. Snail and nudibranch eggs become common on the beach and millions of barnacle larvae settle out and try to establish themselves on every available hard surface. Blennies guard egg masses beneath low intertidal rocks and sculpins hide beneath the sand to protect their eggs. New algae growth is evident on rocks in the low intertidal zone and the sea itself may turn green or brown with the sudden multiplying of phyoplankton, the microscopic, one-celled plants of the sea.

Intertidally, many new organisms are randomly distributed up and down the beach, having been carried hither and yon by waves or changing tides. Soon, however, the forces discussed under the unit on zonation take a heavy mortality, weeding out those young that have settled in inhospitable territory. Thus, the already existing pattern of plant and animal distribution on the beach is reinforced once more.

In areas where glacial pack ice scours the shoreline, or where temporary pollution or other man-originated disruption has eliminated many organisms, a process of ecological succession occurs as new generations settle in the open areas, compete with each other for survival, and gradually establish themselves or are banished.

ACTIVITY 1. Thinking About Spring as a Time of Reproduction and Renewal

Objectives:

- -To encourage students to think about spring and the reasons it might be a time for reproducing.
- -To prepare students to look for signs of reproductive activity at the shore.

METHOD

If in your classroom, you include seasonal projects or discussions in spring, include the shore! Help students realize that spring renewal, awakening occurs at the beach and in the ocean as well as on land. Talk with them about all the things that happen in spring -

new wild animals are born
flowers bloom
grass turns from brown to green, etc.

When you have covered the more obvious ideas, ask what they think might be happening at the beach. Most of them may have seen - female crabs carrying eggs,
the ripening orange egg masses of urchins,
capsule like eggs of snails,
special sand collars with eggs laid by moon snails.

When students understand that spring is a time for new animals, ask them why they think this might be so. Why should new animals be born in spring, why should eggs be laid then, why should algae start to grow and new barnacles settle? The important concept they should realize is that,

The warming temperatures and greater daylight

1. cause new growth to occur so more food is available
2. create less harsh conditions so that the chances of survival are greater than they would be at many other times of the year.

By being born in spring, new plants or animals have the longest possible warm period to gain in size, strength, and food reserves before the cold and dark of the following winter.

ACTIVITY 2. SETTLEMENT OF NEW ORGANISMS ON THE SHORE

Objective:

-To observe spring time settlement of new organisms at the shore

Materials:

scraper	paper and pencil
blowtorch (optional)	magnifying glass
tide table	
marker, such as orange plastic	tape

METHOD

On the calendar and with the help of a tide table, select a day in April or early May when there is a reasonably low tide at a convenient time. You might do best to pick several alternative days in order to allow for inclement weather, change of plans, etc.

Prepare the class for the idea that you are going to go to the shore and clear a small area, mark it, then plan to return to it in several weeks or a month to see what has happened to the cleared area. You might encourage students to put forth their own theories about what might happen in that time span - you might even formally record their suppositions so that latter you can check them against what they actually observe.

On the chosen day at the time of low tide, take the class to the beach and select an area of boulder or bedrock in the low or mid-intertidal zone. Using the scraper or scrapers, clean off an area about one-square foot in size. If you have a small blowtorch, burn the area to insure that no life is left there. In some way, mark the area which you have scraped - you may want to put a small mark of paint at each corner of the plot, tie a brightly colored tape marker to a convenient anchor, or divise some other method of marking. As double insurance that you will be able to locate the plot again, involve the class in making a careful map of the area and deciding how to give themselves direction to finding it again. Like drawing a treasure map!

Return to the plot after several weeks or a month. Test your memories and your map making abilities and see if you can locate the plot. Assuming that you find it, make a careful list of the animals and plants that you find growing in the once cleared area. Record for each organism the number of individuals that you found. Because many of the new plants and animals may be very small, a magnifying glass may be helpful both in counting them and in identifying what they are.

It might be interesting to try this activity with two plots - one in the low intertidal zone and the other higher on the beach - to see if there are any differences in the kinds or number of organisms that settle in the two areas.

When you return to the classroom, copy the plot charts on to the blackboard - or have each child make a copy of it for his or her cummulative record of class marine studies.

ACTIVITY 3. Estimating Barnacle Settlement

Objectives:

- -To develop a comprehension of how many new barnacles settle on intertidal rocks each year.
- -To try some big mathematicl calculations.

Materials:

- -knives or a small instrument for scraping

METHOD

In spring, barnacles set on rocky intertidal areas in abundance. While you are at the shore with your class, choose a small rock covered with new barnacles - this is perhaps best done in May. You may wish to use only one rock for the whole class, divide students into groups with one rock per group, or you might wish to make this an individual activity.

In any event, count the number of barnacles on the rock, try to guess how many similar barnacles there might be on the whole beach area you are studying. If you or class members are mathematically inclined you might rope off a larger square sector, calculate its area in square feet or square inches, then figure out what percentage of that whole area, your rock would be.

Whether you actually calculate the possible number of barnacles in the new set in that area or whether you make a guess, the number you come up with will be huge - and impressive!

ACTIVITY 4. SEA URCHIN RITES OF SPRING

Objectives:

-To realize that sea urchins spawn in spring.
-To see and examine their ripening gonads.

Teacher Background

In spring sea urchins gather in great numbers in shallow waters to spawn. By doing this, they have the highest probability of a large number of eggs being fertilized when eggs and sperm are released into the water.

On a good low tide, many sea urchins lie exposed to the air. If it is spring and they have not yet spawned, their gonads will be ripening and full of eggs or sperm. In many parts of the world sea urchin gonads are regarded as a delicacy and are highly valued as food. Few people in Alaska use them as food, but it is, nevertheless, interesting to show them to students - an example of spring reproduction in the sea and perhaps as a source of survival food!

METHOD

If you are at the beach with your class in May, you could find sea urchins in abundance. While stressing the need to try to avoid stepping on - and thus killing - these prospective "mothers and fathers", students should be able to accept your sacrificing one of these animals for educational purposes.

So break the urchin open carefully and look for the five bright orange masses - the gonads. If you have a magnifying glass, you may want to look at them with magnification.

ACTIVITY 5. How Rockweed and Limpets can Prevent Settlement

Objective:

-To examine some ways that the success of settlement of intertidal plants and animals may be limited.

Teacher Background

As has already been mentioned, many factors act against newly settled plants and animals in the intertidal zone, limiting their numbers or restricting where they can manage to survive. Two of these factors can be observed fairly easily on any rocky beach during the spring.

Rockweed, or Fucus, is like most large algae, a quality means that it sways back and forth and from side to side with every bit of wave action. This whiplash movement often effectively prevents barnacles from settling beneath or around it.

Limpets, in a very different way also affect settling. They are grazers and tend to clear off the area surrounding them by their feeding activities.

METHOD

When you are at the beach carrying out other activities, assign a few students - or the whole class - to look for areas where students can see the evidence of limpet grazing or rockweed movement on settlement of new, springtime organisms.

Unit 5. The Mussel Community

Objective:

-To study one group, or community, of common shore animals.

Teacher Background

The common blue mussel, Mytilus edulis, can be found worldwide. It occurs on rocky intertidal areas, and there it is one of the more dominant life forms. Dense patches of mussels not only mark one of the major zones on beaches but also form a protective environment for many smaller organisms that need cracks and crevices or other tight places in order

to survive. Mussels and their "dependents" form communities that are a distinctive part of the intertidal zone - and that deserve close study.

ACTIVITY 1. MEASURING MUSSELS

Objectives:

- -To demonstrate that some animals, including mussels and barnacles, fall into recognizable size groupings.
- -To realize that size groupings may correspond with age groups.

Teacher Background

Some marine animals, such as barnacles and mussels, grow quite rapidly - especially in spring - when these animals are spawned or settle to a hard surface and begin to grow, and because all barnacles or mussels, for example, in a particular area will grow at about the same rate, measuring the size of numerous individuals and graphing the results will give a visual picture of the ages of animals represented in that location and of their size at a particular age.

Materials:

- -verneir calipers - or rulers
- -graph paper or a substitute
- -pencils

METHOD

1. BARNACLES - When you are at the shore with your class, find an area where small, medium, and large barnacles are living far enough apart that individuals can be measured. Measure the greatest diameter of 40 or 50 barnacles. Make a bar graph of the results and see if you can distinguish several groups that form clusters. Explain to the students that because barnacles all set at the same time and because they grow at about the same rate, these may represent "year classes" - that is, the smallest barnacles may have just set (if you included very, very small individuals) or may be the animals that are one year old. The next clustering would represent animals a year older, and so forth.

Consider developing some math activities with the results you have obtained. How big are the barnacles in each group? How much variation in size is there in each group? How much difference between groups-or how much do the barnacles grow in size from one year to the next?

2. MUSSELS - At the shore, collect 40 to 50 mussels of various sizes down to very tiny ones if you can find them.

Measure the greatest length of each mussel and make a bar graph of the results. Consider some of the same kind of questions included above with the section on BARNACLES.

ACTIVITY 2. ALGAE AND THE MUSSEL COMMUNITY

Objective:

-To determime if algae grow on or among mussels.
-To think about what this may mean to the mussels.

Teacher Background

Mussels are filter feeders, that is, they feed by pulling water into their bodies through an incurrent siphon, filtering out microscopic plants and animals from the water, then expelling the water through an excurrent siphon. In order to feed successfully in this way, mussels must be relatively clean - free from silt and free from other organisms that would interfere with the all-important intake and expelling of water.

If you look closely at a bed of mussels, you will find that very little algae seems to grow there - although algae may be growing luxuriously only a few feet or even inches away. Algae just do not seem to be able to attach to mussel shells and those plants that manage to grow in between mussels are often crowded out.

METHOD

At the shore, either ask the class as a whole or a small group of students to examine a mussel bed closely and note - or collect - all the algae they find growing there. When students have done the job thoroughly, evaluate the quantity of algae found. Ask students how they would categorize the amount of algae found - was it very little, some, a lot.

Involve the students in a discussion of why this might be important to the mussels. You may need to review with them the idea of how mussels feed - you may even want to open a mussel and find the two sihpon openings. Discuss with them the effect that rockweed growing heavily on mussel shells might have on the animals' ability to feed.

ACTIVITY 3. WATCHING MUSSELS AND BARNACLES FEED

Objective:

-To observe mussels and barnacles feeding and to understand what is happening.

Teacher Background

As the tide comes in it covers mussels and barnacles. There animals relax their muscles, allowing a gape to appear in their hard protective coverings, and begin to feed.

In Activity 2, it has been mentioned that mussels are filter feeders that remove tiny food organisms from water that passes through their bodies. Barnacles feed in a different way. They too rely on tiny drifting plants and animals for nourishment, but instead of taking this food from water that enters through an incurrent siphon and is expelled through another siphon, barnacles catch the small plants and animals with a feathery structure that is actually modified legs of this animal that lives with its head permanently cemented to a rock or other hard surface. If it is undisturbed, a barnacle will sweep its food-catching device through the water with a rhythmic repetition, each time bringing the structure into its shell to deliver any food it may have caught.

Material:
-food coloring - optional

METHOD

When you are at the shore, watch carefully to catch the incoming tide as it reaches the zones of mussels and barnacles. With students well protected from wet feet by good rubber boots, gather class members in small groups to watch the feeding activities begin.

When you are observing mussels in action, it may help if you introduce a bit of food coloring to the waters near them. By watching closely, you may be able to see some of the colored water entering one of the mussel's siphons and then being expelled from the other.

Be sure to discuss with students what is happening. Help them understand what the mussel of barnacle is doing, what it is feeding on and how.

ACTIVITY 4. STARFISH AND MUSSELS

Objectives:
-To recognize that just as mussels feed on smaller organisms, so they too are food for bigger animals.
-To think about starfish as animals that feed on mussels.

Teacher Background

Starfish are one of the most important animals that feed on mussels. If a starfish is hungry and comes upon a mussel, it will wrap itself around the bivalve, and gradually pry the two valves apart by using the combined pull of hundreds of tube feet. When the mussel shell begins to gape as the muscles holding it shut relax, the starfish may insert its stomach inside the mussel shell and digest the soft mussel in place instead of pulling it out and swallowing it whole.

Living in the tube-foot grooves on the underside of the starfish may be small scale worms. These animals, so named because of the large, overlapping scales that cover their backs, exist commensally with the starfish. That is, they do starfish no harm but merely benefit by living so closely with it - probable by taking advantage of tiny bits of food that are available to it because of the way the starfish lives and feeds.

METHOD

If while you are at the beach with your class, you are lucky enough to find a starfish feeding on a mussel, be sure to examine it closely and to share the observations with the class. Can they see the tube feet exerting force on the mussel shell? Is there any sign that the mussel shell is beginning to gape? Is the stomach of the starfish extended outside its mouth? Perhaps into the mussel shell?

If you don't find any starfish feeding on a mussels, you could still point out to students that starfish are predators on mussels. Ask them how they think a starfish could eat a mussel. How could it open the mussel's shell? How could it get to the soft mussel to eat it once the shell was open?

While you are examining a starfish and considering these questions, check to see if there is a scale worm living with the starfish. If you find one, examine it closely and ask students what advantage there might be to the worm in living there. Would its being there be good or bad for the starfish or would it make any difference at all to it?

ACTIVITY 5. Examining a Mussel's Muscles

Objective:

-To examine the muscles of a mussel and to compare them with the muscles of other bivalves.

Teacher notes

This activity may be conducted at the beach but it could also be brought into the classroom - either before or after a beach field trip.

Materials:

-a mussel
-one or more other bivalves such as clams or cockles

METHOD

Cut open the mussel and find the muscles that hold the shell closed. Be sure all the students have a chance to see them.

Open the other bivalves, and find the same muscles. Are they in the same position in the shell as those of the mussel?

If you conduct this activity at the beach, feed the remains of the mussel and other bivalves to one or more anemones that are open in shallow waters. You may find small anemones in tide pools for this. Encourage class members to observe what happens when the food pieces are placed on the tentacles of the anemone.

ACTIVITY 6. Counting Byssal Threads

Objective:

-To become aware of the byssal threads, or byssus, of mussels - to examine it closely and know how it is formed and how it functions.

Teacher Background

While you are examining other aspects of the mussel community at the beach, find a place where individual mussels can be isolated. Have several - or all - students select one mussel and count the number of threads holding the mussel in place. How many does each mussel have?

Test the strength of the threads. If one thread can be isolated, see how much force is needed to tear it free. Choose ONE mussel that is particularly well anchored and find out how much pull must be exerted to remove it from its place of attachment.

ACTIVITY 7. LIMPETS IN THE MUSSEL COMMUNITY

Objective:

-To be aware of limpets as a part of the mussel community.

Teacher notes

Limpets live in and around mussel clumps, usually grazing on films of microscopic plants that form on the rocks. They feed by use of radula, a rough "tongue" with many minute hooks or teeth that are used for scraping.

METHOD

While at the shore involved in studying the mussel community, remind students to watch for limpets. It they find some, quickly and carefully pry one loose. (The essence of this is to be quick and to surprise the animal before it clamps down tightly to the rock beneath it. Sometimes a knife or putty knife is a help in dislodging them.)

Examine the mouth of the animal. You may find traces of what it had been eating. If you have a hand lens, you may want to cut the animal open near its mouth and pull out the long radula so you can examine it under magnification. If you have a microscope at school, you may want to take back a limpet and do this in the classroom. Note the hook-like projections that do the actual work of scraping up food.

SOUTHEAST ALASKA

A Landscape Carved By Glaciers

by

Patrick Thrasher
USDA Forest Service

Outline

I. Recommended Prerequisite Material

II. Classroom Activities

- A. Modern glaciers and icefields of Southeast Alaska - a mapping activity
- B. McGraw Hill film "How We Know About The Ice Ages"
- C. Slide program "Glaciers Around You"
- D. Classroom observations of the properties of ice
- E. Geologic time line and glacial history

III. Field Investigations

IV. Bibliography

I. Recommended Prerequisite Material

To achieve the greatest benefit from these activities, three topics should be discussed before working on this unit. To fully understand how a glacier forms and operates, students must first have a basic understanding of the properties of water and the water cycle. To complete the mapping activity, students should understand the usefulness of a map and be able to read one. Before working with the observations of the properties of ice students will need to be familiar with the concept of volume and how volume is measured.

These concepts should be covered sufficiently in your science and geography texts. You may find it desirable to review them with the class as a lead into these activities.

II. Classroom Activities

A. Modern Glacier and Icefields of Southeast Alaska - A Mapping Activity

This activity is designed to acquaint your students with basic geography of Southeast Alaska and the location of the major icefields and glaciers of the region.

1. Distribute Tongass National Forest maps to the class, one map per student.
2. Briefly discuss how to read a map. Mention the legend, scale, direction and principal abbreviations.

Task A - Mapping Activity

1. Find your town on the map. Locate the glacier closest to your town.

2. *Many glaciers in Southeast Alaska are un-named. Those that are named are*

labeled on the maps. ("Gl" is the abbreviation for glacier.)

How many named glaciers are located within fifty miles of your town?

3. Is your town near an icefield? Outline the boundaries of the icefield. Are there other glaciers that have the same source as the glacier near your town? How did your glacier get its name? How did the other glaciers get their names?

4. Find other glaciers and icefields in Southeast Alaska. (They may not all be named.)

Where are most of them located?

5. Can you find any glaciers on islands? Where are they?

6. *The land forms of Southeast Alaska were formed by glacial activity 10,000 - 2,500,000 years ago.*

Describe the land forms of this area. How might they have been caused by glaciers?

7. How might the unique land forms of Southeast Alaska affect the kinds of marine life here?

Glaciers have been called "nature's bulldozers". As an erosive power, they are the stongest force at work altering the shape of the earth's surface. Glaciers are best defined a a body of ice in motion over a land surface. The moving ice has all the properties of a viscious fluid. It follows a path of least resistance as it moves from its source in an icefield down through a valley towards its terminus. The moving ice picks up sand, rock and gravel from the valley floor and uses this material to grind away the surrounding bedrock carving the typical steep walled u-shaped valley of a glacial landscape. As a result of glacial activity during the four major ice ages of the Pleistocene (beginning about 2.5 million years ago and ending about 10,000 years ago) what had been river valleys before the ice ages were carved out to become the Inside

Passage. The Inside Passage is really a series of flooded glacial valleys.

Several factors contribute to the richness of the marine environment of the Inside Passage. Some of these may be related to the glacial origin of the waterway while others are in part related to the presence of modern glaciers along the waterway. Glaciers of the past have carved deep narrow valleys with steep side walls which are relatively protected from the storms of the open ocean. Because of this protection these waters tend to be calmer and warmer. The climate of the region is such that an abundant supply of nutrient rich fresh water is constantly being delivered from the land to the waters of the Inside Passage. A major source of this nutrient rich water are the many glaciers and glacially fed rivers which flow into the Inside Passage.

B. Show McGraw Hill film "How We Know About The Ice Ages"

A teacher's study guide accompanies the film and may be found on the inside of the film cannister. The major concepts to be stressed are the formation of glacier ice from snow, the fact that the ice is flowing in a glacier and that by observing the landscape around modern glaciers we can learn more about the glacial history of an area.

C. Show the slide program "Glaciers Around You"

The slide program is designed to be shown to the group twice. The first showing is with only a music accompananiment or no audio at all. At the conclusion of the first showing, have the students complete Task B. (Slide program available from U.S. Forest Service, Juneau.)

TaskB - "Glaciers Around You" activities

1. Write a paragraph describing what you saw.

2. Sketch a scene of a glacier or something related to it.

You may want the students to either write a description of their sketch or explain it to the class.

Now show the slide program using the tape narration or the following script to narrate it yourself. The tones on the tape indicate slide changes.

Glacier Around You

* slide change here

Glacier Aerial — *What is a glacier?

Where does a glacier form?

Why does a glacier form?

How does a glacier work?

How does a glacier affect you and your environment?

Mendenhall — *These are all questions you can answer just by exploring the area around Juneau.

Cloudy View — *When the warm, moist air coming from the ocean hits the high mountains around Juneau, it rises and cools. When this happens, the air cannot carry as much moisture. What it cannot hold it drops. In the high mountains it falls

Icefield — as snow. * Most of the Snow stays there from one year to the next and does not melt. As more and more snow falls, the more deeply buried snow slowly changes to very hard ice. An area where snow and ice build up and do not melt is called an icefield, like the Juneau Icefield.

Glacier Ice — *The ice in an icefield is not like the ice that forms

on a lake or ice made in a freezer. Because of the weight from the accumulating snow, the deeply buried ice can flow

Mendenhall Glacier

over the land, pulled by gravity. *When this happens, the moving ice is called a glacier, like the Mendenhall Glacier.

Dirty Ice

*As a glacier moves down the mountian from the icefield, it picks up rocks and gravel. The glacier uses the rocks and gravel to grind down or erode the floor and walls of the valley it is moving through, just as a carpenter might use a piece of sandpaper.

Mendenhall Glacier

*Down at the terminus or face of the glacier, the glacier is fighting a battle with the warmer air and rain. The warm air and rain cause the ice to melt away. If the glacier melts faster than it can flow forward, it loses the battle and retreats up the valley. Today the Men-

Taku Glacier

denhall Glacier is losing the battle. *If the glacier flows faster than it melts, the glacier wins and advances down the valley. Today, the Taku Glacier is winning the battle.

Moraine

*As a glacier retreats, it drops its load of rock and gravel, often many miles from where it was picked up. When left behind by a glacier, this material is called

Moraine Diagram

a moraine. *Lateral moraines are left along the sides of the valley. The ground moraine is spread across the valley floor. The terminal moraine is a low ridge running across the valley connecting the lateral moraines on each side of the valley. The terminal moraine marks the

farthest advance of a glacier down its valley.

Moraine — *The rocks, sand and gravel that make up the moraines serve as the beginning of a new soil for plants which very quickly invade an area uncovered as a glacier

Mosses & Lichens — retreats. *Often the mosses and lichens come first, followed closely by the grasses. As these plants die they decay, adding much needed nutrients to the soil.

Willow & Alder — *As the soil develops, alders and willows move in

Spruce — *only to be replaced by the Sitka spruce and western hemlock. This is the forest which covers most of southeast Alaska today.

One group of plants being replaced by another is called plant succession.

Muddy Water — *Much of the rock picked up by a glacier is ground so fine that it feels just like flour. This "glacial flour" stays suspended in the melt water from the glacier, giving it the milky brown or green color.

Mendenhall River — *Much of the glacial flour or silt ground up by the Mendenhall Glacier is carried away by the Mendenhall River. When the river flows into the calm waters of the

Wetlands — Gastineau Channel and Fritz Cove, *it drops its load of silt in an ever growing delta called the Mendenhall Flats or Wetlands. Given enough time, the river might carry enough silt down to fill up the north end of the Gastineau Channel and connect Douglas Island to the mainland. Today, even small boats have to wait for high tide

to travel through the channel from town to Fritz Cove. Most of the large tide flats along the Inside Passage are at the mouths of glacial rivers.

Tide Flats

*The wetlands and tide flats are home for many plants and animals that depend on the continued supply of silt brought in by the river. Plants like grasses and sedges root in the mud, while seaweeds and kelps attach to occa-

Submarine Animals

sional rocks and sunken logs. *Animals like the clams, snails, and worms burrow into the mud for food and protection. Other animals find food and protection among the

Geese

seaweeds and grasses. *Birds like the ducks and geese come to rest and feed as they migrate north and south while some nest here and others even spend the winter here.

Plankton

*Plankton are the smallest plants and animals in the waters of the earth. Most plankton are so small that they cannot be seen by the naked eye. Plant plankton are called phytoplankton. Animal plankton are called zooplankton.

Willow

*On land, green plants take nutrients and water from the soil and with carbon dioxide from the air and

Sitka Deer

sunlight produce food so they can grow *and reproduce. This process is called photosynthesis. Some animals feed upon the plants so that they may grow and reproduce.

Wolf

These animals are called grazers. *Other animals feed on the grazers and so on. When the plants and animals die, their remains decay and return to the soil to be used as nutrients by other plants. This dependence of

plants and animals on one another is called a food web.

Marine Food Web

*In the waters of the Inside Passage the same kinds of food webs exist. Some of the minerals in the silt dissolve into the water. These dissolve minerals become nutrients for the phytoplankton or plant plankton. The smallest animal plankton or zooplankton feed on the phytoplankton and are fed upon by larger and larger animals like shrimp, salmon, sea lions and whales.

Mendenhall Glacier

Riggs Glacier

*Mendenhall Glacier is a land locked glacier. Only its silt laden melt water reaches the sea. *A tidewater glacier is one which comes down to terminate or end in the sea. There are several tidewater glaciers in Glacier Bay. *Because of the many nutrients added to the water by a glacier, the water at the face of tidewater glacier is very rich in many forms of life. *Many animals such as birds, porpoises, killer whales and seals come in to take advantage of the good eating. *The seals even use the icebergs as a place to raise their young.

Bird on Iceberg

Killer Whale

Seal on Ice

Inside Passage

*Glaciers of the present add a great deal to the life of the Inside Passage. But were it not for glaciers of the past, the Inside Passage would not exist. *By studying the glaciers and icefields that are here today we can get an idea of how glaciers of the past worked. Put your imagination in gear and travel back in time two and a half million years ago. *That's a long time ago, but you can do it. Now, imagine that what is not the Inside Passage is a group of river valleys. Two and a half

Glacier View

River Valley

million years ago the first of the great ice ages began.

Icefield

*During each of the four ice ages, a great glacier a mile thick moved over Southeast Alaska carving out those river valleys, so that when the last ice age came to an

Inside Passage

end and the great glacier retreated, *the ocean flodded into the valleys and created the Inside Passage.

Mendenhall Glacier

*So you can see that the glaciers of the past and the glaciers that are here today have a great deal to do with what you see all around you.

D. Classroom Observations of the Properties of Ice

There are major differences between the ice which is frozen in a freezer and that which is in a glacier. Some of these differences can be observed in the classroom if there is a source of glacier ice close at hand. Try to obtain some glacier ice or have it delivered to your school by a parent. You should freeze a half gallon milk carton, filled with tap water. After the water has frozen, peel away the carton.

Because it has formed as a result of both cold temperatures and high pressure, the glacier ice should have a higher density. This is the reason that icebergs float considerably lower in the water than lake or freezer ice. This concept can be demonstrated in the classroom with very simple equipment.

Ice Density Demonstration

Equipment: Lab balance; 5 gallon aquarium; meter stick

1. Mount the meter stick vertically in one corner of the aquarium.
2. Fill the aquarium approximately two thirds full of cold water. Calculate the volume of water in cubic centimeters. (For the best results the water level should come to a centimeter mark.)

3. Weigh the glacier ice and freezer ice on the balance scale and record the weights.

(Liquid water has a density of 1 which means one cubic centimeter of water weighs one gram. Ice has a density less than 1 meaning that a piece of ice with a volume of one cubic centimeter should weigh something less than one gram.)

4. Carefully place the freezer ice in the tank. Record the new water level in the tank. Repeat the process for the glacier ice.

Task C

	weight	change in water level	volume displaced	density
	*	*	*	*
Freezer Ice	*	*	*	*
	*	*	*	*
Glacier Ice	*	*	*	*

Formula for Volume Displaced:

(New water level - old water level) (tank length) (tank width) = volume displaced (Cubic Centimeters)

Formula for Density:

$$\frac{\text{(Weight of ice)}}{\text{(Volume displaced)}} = \text{Density (grams/cubic centimeter)}$$

(The glacier ice should have a slightly higher density than the freezer ice, melt more slowly and contain more water when melted.)

Melting Rate

Place the two pieces of ice in separate pans on the table. Label one "freezer ice" and the other "glacier ice". Leave them there. Keep a class record of the time it takes for the two pieces to melt. At the end of the day return any remaining ice to the freezer. The next morning take it back to the classroom and continue the class record until both chunks have melted.

Task D - Observing and Comparing Ice Samples

1. Keep a class recordof the time it takes the two pieces of ice to melt.

D&T=Date and Time	D&T	D&T	D&T	D&T	D&T
Glacier Ice					
remove from freezer					
return to freezer					
melted					
Freezer Ice					
remove from freezer					
return to freezer					
melted					

Be sure to save the water that melts off the ice chunks each day. Keep it in two glass jars labeled "glacier water" and "tap water".

2. Spend several minutes looking at the ice samples. Write a list of words to describe the glacier ice and another list to describe the freezer ice.

Discussion and Questions

1. Which pieces of ice melted most rapidly?
2. What might have caused it to melt sooner?
3. With two pieces of ice exactly the same size would you expect the same results?
4. (Show the class the two jars of water.) Which piece of ice contained more water?
5. What might be the reason for that?
6. How are glacier ice and freezer ice similar?
7. How are they different?
8. What might have caused these differences?
9. Glaciers carry large loads of rock, pebbles and silt. Can you see any in your glacier ice sample?

10. How might silt carried by glaciers affect marine creatures?

When glacial ice melts, much of the silt carried by the glacier stays suspended in the water. Silt in the water restricts sunlight from penetrating the water and inhibits plankton blooms. Without plankton, many aquatic animals cannot live.

As the silt settles to the channel floor, nutrients dissolve into the water and nourish aquatic plants, which are a food source for aquatic animals. The high productivity of the waters of the Inside Passage is due in part to the nutrients from silt carried by glaciers to the sea.

E. Geologic Timeline Activity

It is often difficult for students to visualize the wide span of time involved when talking about the glacial history of Southeast Alaska. A geologic history timeline is one way to this. You will need a 100 foot tape measue, a supply of 5 x 7 note cards and a roll of masking tape. Transfer the information from the "number of years ago" and "event" column to the cards. Along a hallway mark off a 200 foot timeline using the information in the "timeline" column. You may find it desirable to use a ruler marked in tenths of feet.

ie:

Geologic Timeline

200' Timeline	No. of Years Ago	Event
0.00'	2,500,000	beginning of Pleistocene Epoch
104'	1,200,000	beginning of Nebraskan ice age
129.6'	880,000	end of Nebraskan
140'	750,000	beginning of Kansan ice age
152'	600,000	end of Kansan

170'	375,000	beginning of Illinoian ice age
180'	250,000	end of Illinoian
190'	125,000	beginning of Wisconsin ice age
192'	12,000	end of Wisconsin
193.5'	4,000	beginning of Little ice age
196'	250	end of Little ice age Mendenhall Glacier at maximum advance during Little ice age, near what is now back side of Mendenhall Loop Road. Mendenhall Glacier begins to retreat.
196.25'	238	1741 Bering discovers Alaska
196.75'	203	1776 American Revolution
197.25'	112	1867 Alaska purchased from Russia
198.4'	100	1879 John Muir called Mendenhall Glacier the "Auk Glacier"
198.6'	87	1892 Mendenhall Glacier given its modern name
198.7'	82	1897 Beginning of Klondike Gold Rush
199.4'	39	1940 site of the Mendenhall Glacier Visitor Center uncovered by the retreating ice
199.7'	20	1959 Alaska Statehood
199.75'	17	1962 Mendenhall Glacier Visitor Center built
199.85'(approx)	(9)	19(70) members of your class were born
200'	0	1979 the present

III. Field Investigations

A FIELD INVESTIGATION FOR SOUTHEAST ALASKA A LANDSCAPE CARVED BY GLACIERS

The objective of this investigation is to increase an awareness and understanding of the land forms of a glacially worked landscape. The focus is primarily on land form or shape and vegetative patterns. Although best accomplished in an area where you can visit a glacier, the facilitator using this lesson plan in most Southeast Alaska communities should be able to adapt it to his/her location.

You will need to locate several sites before you work with your group. Examine the road cuts and gravel pits in your area, especially those along steep valley walls to locate a cross section of a glacial till or moraine deposit. In the same area locate a clean bedrock exposure which showsglacial striations or scratches. You may want to consult a local construction or highway engineer of the soils specialist with the local Forest Service office. You will also want to locate an area which provides an open view of a fairly large valley and surrounding mountains, as most of the activity will require that participants be able to have a panoramic view of the landscape to be investigated.

List of Materials Needed

- clip boards
- pencils
- 8½ x 11 drawing paper
- hand lenses or magnifying glasses
- spade
- chart paper
- marking pens
- topographic maps of your area
- grease pens
- clear acetate sheeting or tracing paper
- 1 gal. jar w/screw on lid
- task cards
- marine navigation charts of your area

Set the Stage

As an introduction to the investigation, quickly review the concepts covered in the classroom activities. Emphasis should be placed on the fact that the ic ice flows and as it does, it picks up, transports, and deposits large quantities of material and in the process uses this material to carve the landscape.

The Investigation

I. Observing the Landscape

Distribute Task A.

"On your Task Card write a brief paragraph which describes the landscape around you." (10 min s)

> TASK A (individuals)
> Write a brief paragraph which describes the landscape around you.

Distribute Task B

"Working in small groups, ovserve and record as many things as you can about landscape." (15 minutes)

TASK B (individuals or small groups)
As you look at the lanscape, ovserve and record as many things as you can about it.

Landscape

Vegetation Patterns

Patterns in bed rock

Other

Questions and Discussion (list responses on the chart paper)

1. "What are some of the things you noticed about the landscape?"

2. "What are some of the things you noticed about the shape of the mountains? The valley?"

3. "What are some of the things you noticed about the patterns in the vegetation?"

4. "How does the shape of the lower mountains differ from the taller mountains?"

5. "How do the vegetation patterns change as you move from the valley floor to the top of the mountains?"

6. "Why might the shape of the mountains change?"

7. "Why might the vegetation patterns change?"

II. Observing the Bedrock
Move the group to your bedrock site. Distribute TASK C and hand lenses. "As you observe the bedrock, record your findings." (10 minutes)

TASK C (individuals or groups)
As you abserve the bedrock, record you findings.

Shape

Patterns

Marks

Feel

Questions and Discussion

1. "What are some of the things you noticed about the bedrock?"

2. "What are some of the things you noticed about the feel of the bedrock?"

3. "What are some of the things you noticed about the marks in the bedrock?"

4. "How might these marks have been made?"

III. Observing A Glacier Deposit

Move the group to your glacial till or moraine deposit site. Upon arrival at the site, place a spadeful of the glacial deposit in the one gallon jar (about ¼ full) and fill the jar with water. Tightly screw on the lid and vigoruously shake the jar, mixing the contents throughly. Set the jar aside and continue with the rest of the activity.

Distribute TASK D

"As you examine the area, record your observations on the task card."

> TASK D (individuals or small groups)
> As you examine the area, record your observations.
>
> Size
>
> Shape
>
> Feel
>
> PART 2
> Record your observations of the contents of the jar.

Questions and Discussion

1. "What are some of the things you noticed about the deposit?"

2. "What are some of the things you noticed about the size of the material in the deposit?"

3. "What are some of the things you noticed about the shape of the material?"

4. "What are some of the things you noticed about the material in the jar?"

5. "How might this deposit have been moved here?"

6. "How might this deposit differ from one which was deposited by a creek or river?"

IV. Observing Land Forms on a Map

Facilitator Note: In preparation for this part of the activity you will want to mount the topographic maps and marine charts to a piece of cardboard and cover them with the acetate sheeting or tracing paper so they can be drawn on and yet preserved for future activities. You may also find it desirable to start this portion of the investigation in the field and then return to the indoors to complete it.

Distribute the topographic maps, marine charts and TASK E.
"Complete TASK E, recording your observations as you proceed." (30 min.)

TASK E

1. Locate you study area on the topographic map. Draw a line around the area you see.

2. Describe the pattern of the contour lines across the valley.

3. Describe the pattern of the contour lines up the valley.

4. Locate your study area on the marine chart. The water depths are shown in fathoms or fractions of fathoms(one fathom equals six feet).

5. Describe the pattern of water depths across the water body.

6. Describe the pattern of water depths as you go away from shore out the water body.

Questions and Discussion

1. "What are some of the things you noticed about the shape of the valley?"

2. "What are some of the things you noticed about the shape of the bottom of the water body?"

3. "How might the shape of the valley and the bottom of the water body be related?"

V. Summary

"Write a second paragraph which describes the area we have been observing." (ten minutes)

Questions and Discussion

1. "What are some of the things we observed today?"

2. "What are some of the things that might have caused the land forms we observed today?"

Facilitator Note: Master for the TASK CARDS for this investigation follow. You will want to reproduce enough copies of each card for your group. Your largest working group should not be more than four individuals.

TASK A (Individuals)

Write a brief paragraph which describes the landscape around you.

TASK B (Individuals or small groups)

As you look at the landscape, observe and record as many as you can about it.

Land Shape

Vegetation Patterns

Patterns in Bedrock

Other

TASK C (individuals or small groups)

As you observe the bedrock, record your findings.

Shape

Patterns

Marks

Feel

62

TASK D (Individuals or small groups)

Part 1
As you examine the area, record your observation.

Size

Shape

Feel

Part 2
Record your observations of the content of the jar.

TASK E (Individuals or small groups)

1. Locate your study area on the topographic map. Draw a line around the area you see.

2. Describe the pattern of the contour lines across the valley.

3. Describe the pattern of the contour lines up the valley.

4. Locate your study area on the marine chart. The water depths are shown in fathoms or fractions or fathoms (one fathom equals six feet)

5. Describe the pattern of water depths across the water body.

6. Describe the patterns of water depths as you go away from shore out the water body.

BIBLIOGRAPHY

1. Anthony, Leo Mark and Tunley, A. Tom, 1976, Introductory Geography and Geology of Alaska, Polar Publishing, Anchorage, Alaska

2. Bloom, Arthur L., 1969, The Surface of the Earth, Foundations of Earth Science Series, Prentice-Hall, Inc., Englewood Cliffs, N.J.

3. Eicher, Don L., 1968, Geologic Time, Foundations of Earth Science Series, Prentice-Hall Inc., Englewood Cliffs, N.J.

4. Flint, Richard Foster, 1971, Glacial and Quaternary Geology, John Wiley & Sons, Inc., New York, N.Y.

5. Leet, L. Don and Judson, Sheldon, 1965, Physical Geology, Prentice-Hall, Inc., Englewood Cliffs, N.J.

6. Paterson, W. S. B., 1969, The Physics of Glaciers, Pergamon Press, New York, N.Y.

7. Sharp, Robert P., 1960, Glaciers, Condon Lecture Series, University of Oregon Books, Eugene, Oregon

8. Wood, Elizabeth A., 1975, Science From Your Airplane Window, Dover Publications, Inc., New York, N.Y.

TEACHER INFORMATION
FOR
SEA WEEK CURRICULUM MATERIALS

-

3rd GRADE

Name of Sea Week Materials	Contents and/or Use
1. "ABOUT THE BEACH"	Stories and Question
#1. Seashore Zones 1-A - Testing Yourself Say & Know Getting Ready to Read	
#2. Zones on a Rocky Seashore 2-A - Testing Yourself Say & Know Getting Ready to Read	
#3. Sea Weeds 3-A - Testing Yourself Say & Know Getting Ready to Read	
#4. Rockweed 4-A - Testing Yourself Say & Know Getting Ready to Read	
#5. Bedrock, Boulders, or Mud 5-A - Testing Yourself Say & Know Getting Ready to Read	
#6. Spring at the Shore 6-A - Testing Yourself Say & Know Getting Ready to Read	
#7. Mussels and How They Feed 7-A - Testing Yourself Say & Know Getting Ready to Read	
#8. How a Starfish Can Eat a Mussel 8-A - Testing Yourself Say & Know Getting Ready to Read	

Ed. note:
There is also a game called "Tide's In" and a slide-tape show "Glacier's Around You" developed by & available at the South East Regional Resource Center, Juneau, Alaska 99801.

SEASHORE ZONES

Every plant or animal needs certain things from the world around it in order to survive. Some plants and animals can live only in cold places, some can live only where it is warm. Some live only in dry places, some live only in rivers or in the sea. Each plant or animal has its own ability to adapt to the world around it. Some plants and animals can live in many different kinds of places, but others can survive only if the world around them is just so.

The sea shore is one kind of environment or place, but even it is made up of smaller parts, each with its special kinds of life. For example, the plants and animals that live high on the beach are different from those that live near the low tide level. How high or low on the beach a plant or animal can live depends on many things like where the plant or animal can find the food it needs, how much light it can stand, and how well it can keep from drying out when it is in the air. Also important are whether the plant or animal can survive in the waves that hit the shore, whether it can stand being in freshwater such as rain, and how well it can "fight" with other plants and animals that want to live in the same place.

TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. Every plant or animal needs certain things to _____.

2. From the story you can tell

   a. plants and animals can live anywhere.

   b. if an animal or plant doesn't find the right place to live it may die.

   c. plants don't like animals.

3. The story as a whole is about

   a. animals. c. plant and animal homes on the beach.

   b. plants. d. plant and animal fights.

4. Plants and animals have the ability

   to adapt to their environment. Yes No Does not say

5. Plants and animals sometimes have to

   fight for their place on the beach. Yes No Does not say

6. What word in the first paragraph means to change or to adjust to new

   conditions? _____

SAY & KNOW

tight

solid

feed

swollen

crevice

described

shore

clinging

GETTING READY TO READ

Draw a line under the right answer or fill in the blank.

1. Another word for a crack is *crevice shell glacier.*

2. Not hollow means the same as *hard soft solid.*

3. It means enlarged *tight swollen squeezed.*

4. To eat is to *feed hide cling.*

5. If it is holding tightly to a rock it is

   leveling clinging eating

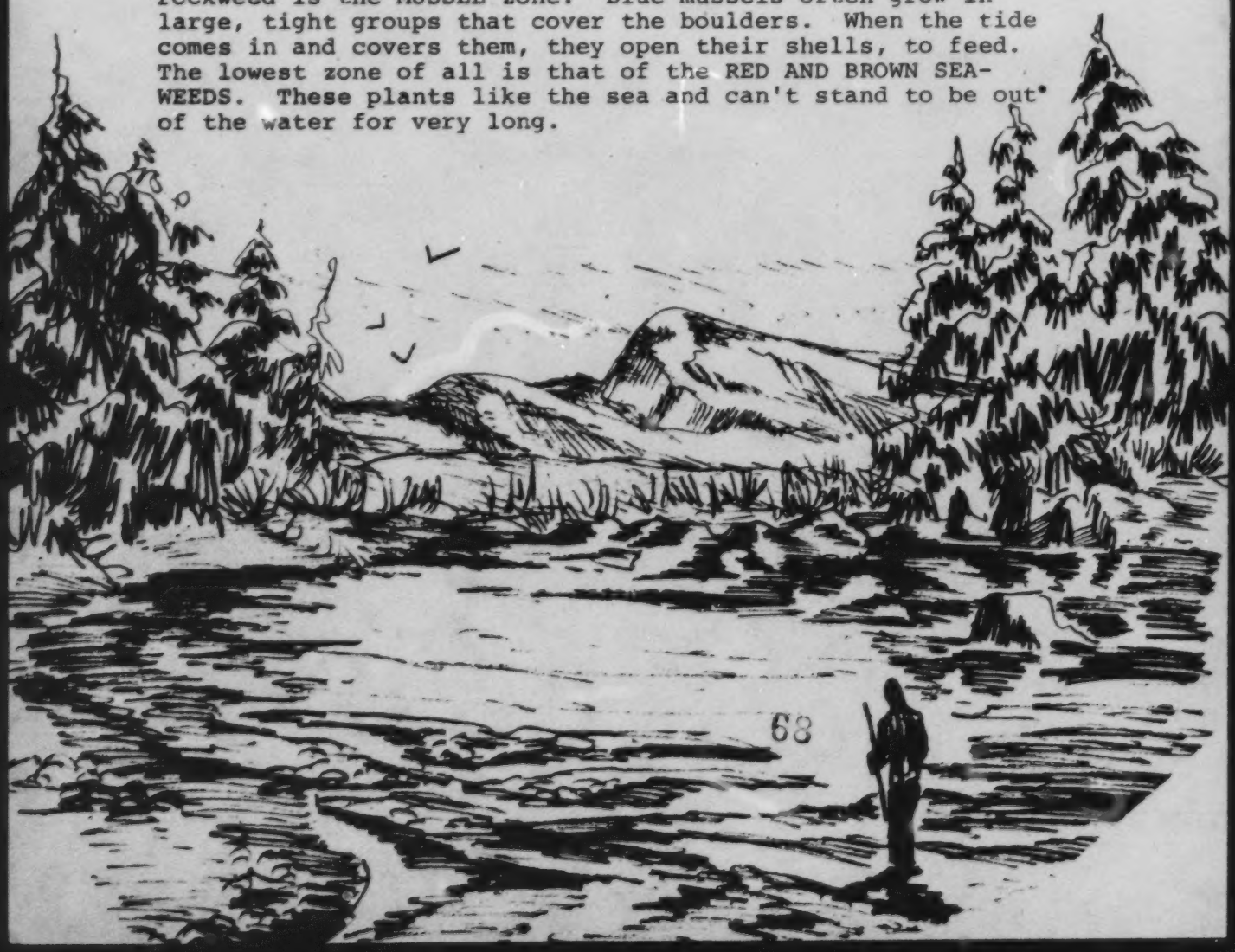
6. If you are talking about something and tell people

   how it looked you have _____ it.

ZONES ON A ROCKY SEASHORE

Many different kinds of plants and animals grow on rocky beaches because there are small cracks and crevices in which to hide and there are solid rocks to which to cling. From the low tide level to the highest part of the beach, plants and animals seek the kind of place where they can best survive. Some of the shore plants and animals are very small but others are large and easily seen. The names of some large ones are used to describe five different kinds of zones on rocky shores.

Highest of all on a rocky beach is the BLACK LICHEN zone. Black lichens are tiny plants that make rocks look black. They need to be wet by the sea only once in a while. A bit lower than the lichens is the BARNACLE zone. Barnacles can tightly close their shells to keep from drying out in the hot sun. Below the barnacles is the ROCKWEED zone. Sometimes rockweed is called pop weed because it may have swollen tips that pop when squeezed. Not far from the rockweed is the MUSSEL zone. Blue mussels often grow in large, tight groups that cover the boulders. When the tide comes in and covers them, they open their shells, to feed. The lowest zone of all is that of the RED AND BROWN SEAWEEDS. These plants like the sea and can't stand to be out of the water for very long.



TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. Lots of animals and plants live on rocky beaches because there are good places to _____.

2. From the story you can tell that

   a. Red and Brown seaweed are covered by water most of the time.

   b. there are more high tides than low tides.

   c. barnacles are plants.

3. This story as a whole is about

   a. rocky beaches. c. mussels.

   b. rockweed.

4. Pop weed is called that because soft drinks are made from it. Yes No Does not say

5. Black Lichen grow in the zone farthest away from Red and Brown seaweed. Yes No Does not say

6. What word in the first paragraph, first sentence means unlike?

_____

SAY & KNOW

survive

shallow

surrounded

grouped

pigment

chlorophyll

algae

planted

GETTING READY TO READ

Draw a line under the right answer or fill in the blank.

1. To have something all around you is to be

   grouped *gathered* *surrounded.*

2. Water that is not deep is *algae* *shallow* *shore.*

3. It means tint or color. *pigment* *survive* *plants.*

4. To be selected according to size is to be

   planted *timed* *grouped.*

5. Another word for seaweed is *pigment* *algae* *grass.*

SEAWEEDS

Seaweeds are the plants that live in water. They must be surrounded by water all or most of the time in order to survive. Another word for seaweed is "algae."

Like most plants, seaweeds have in them a green color pigment called chlorophyll that helps them make their own food. Many seaweeds have other color pigments too and sometimes these make them look brown or red or some other color.

The large seaweeds on our shores are grouped by the kinds of pigments they have. There are three main groups. GREEN SEAWEEDS have only green pigments. They need a lot of light to make their food, so they can grow only in very shallow waters. BROWN SEAWEEDS have green and brown pigments. Because they have brown pigment, they need less light to make food than green seaweeds do. That means they can live in deeper water. RED ALGAE have green and red pigments. They look red or purple and can live deeper than the other large seaweeds.

TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. A kind of plant that lives in the water is called _____.
2. From the story you can tell that
   a. seaweed can be many colors.
   b. seaweed is an animal.
   c. seaweed is only green.
3. This story as a whole is about
   a. pigment.
   b. seaweed.
   c. beach zones.
4. Chlorophyll is green colored pigment. Yes No Does not say
5. Green seaweed grows in very deep water. Yes No Does not say
6. What word in the first paragraph, second sentence means to live _____.

SAY & KNOW

blades
rockweed
cells
zones
squeeze
stormy
roots
leafy

GETTING READY TO READ

Draw a line under the right answer.

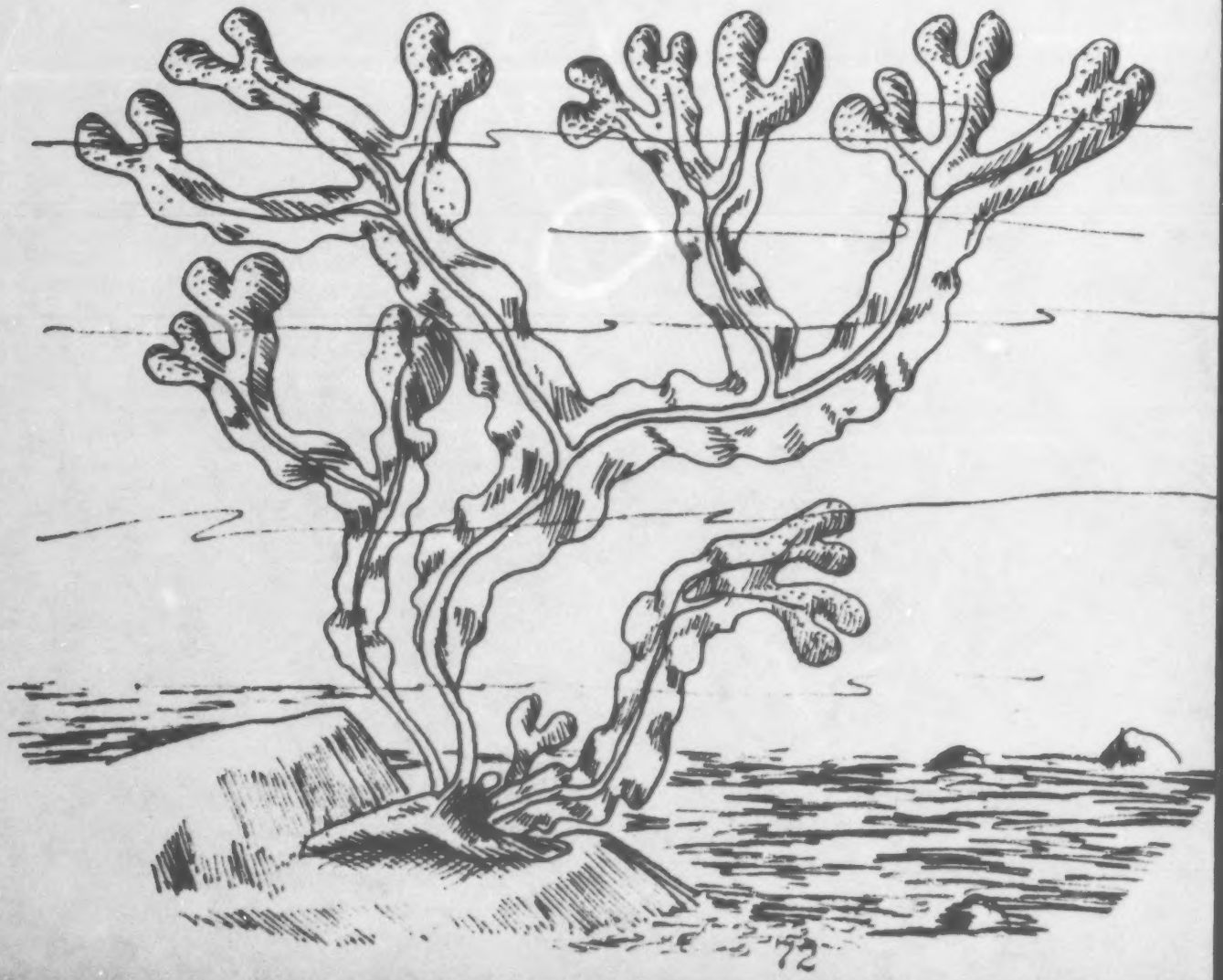
1. It is a common seaweed on rocky shores
   blades *rockweed* *roots.*
2. They are areas on a beach *disc* *zones* *cells.*
3. To pinch means the same as *squeeze* *bite* *swell.*
4. A round, flat object. *zone* *roots* *disc*
5. When weather is bad it is said to be
   clear *stormy* *calm*

ROCKWEED

Rockweed is one of the most common seaweeds on rocky shores in Alaska. It usually lives well above the low tide line and it marks one of the five main zones on the rocky beaches.

Rockweed is called Fucus distichus by scientists. It belongs to the BROWN SEAWEEDS because it has brown pigment in it. Rockweed really looks yellow-brown. The tips of the blades, or leafy part of the plant, swell up in the spring and contain the tiny cells that will become new plants. If you squeeze the swollen tips between your fingers or step on them, they will make a popping sound.

Like all plants that live in the sea, rockweed bends easily and is not broken or damaged when the sea is stormy and the waves are large. Rockweed has no roots. Instead it has a small round disc called a holdfast. The holdfast can fasten tight as glue to a rock or shell, and it keeps the plant from being carried away by the sea.



TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. Rockweed is a Brown Seaweed because it has brown _____.
2. From the story you can tell
   a. rockweed is found on rocky beaches.
   b. rockweed is found on sandy beaches.
   c. rockweed is found on muddy beaches.
   d. rockweed is found on all beaches.
3. It means ordinary. Rare Uncommon Common.
4. To connect is to bend fasten pop.
5. If it is the leafy part of the Rockweed it is called
   a. the roots.
   b. the blades.
   c. the disc.
6. What word in the second paragraph means points or ends? _____

SAY & KNOW

discover

imagine

struggle

special

scurry

fight

edge

GETTING READY TO READ

Draw a line under the right answer.

1. If you form an idea in your mind you
   scurry *imagine* *hide.*
2. It means to hurry along *scurry* *fight* *hide.*
3. A great effort means the same as
   boulder *struggle* *feel.*
4. The opposite of lower is *super* *story* *upper.*
5. To find something is to *discover* *struggle* *live.*
6. The lip or rim of a boulder is its
   line *edge* *middle*

BEDROCK, BOULDERS, OR MUD

At the beach there are many different kinds of places. Imagine you are a tiny crab and think about how it would feel to scurry over sand or mud, to hide under the edge of a big boulder or to struggle over rough gravel. If you were a crab, you would probably like the feel of the sand best - but if you were rockweed or a mussel, you wouldn't like the sand at all.

Every plant and animal living at the beach has a special place it would most like to live. Clams live buried in sand or mud, barnacles like to be on the upper sides of rocks, and brittle stars or worms hide between the rocks and mud. Some animals need to live under seaweeds or in cracks because then they have more protection. Other animals, like mussels, must live out in the open so they can open their shells to feed when the water covers them.

When you go to the beach, see how many kinds of places you can find and try to discover which animals like to live in each place.

TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. At the beach there are many different kinds of _____.
2. From the story you can tell
   a. most animals have favorite places to live.
   b. all animals and plants live everywhere.
   c. mussels like to live in sand.
3. This story as a whole is about
   a. where mussels like to live.
   b. places animals and plants like to live.
   c. where seaweed likes to live.
4. Animals pick places to live that give them protection.
   Yes No Does not say
5. Mussels eat when water covers them. Yes No Does not say
6. What word in the second paragraph third sentence means safety.

_____

SAY & KNOW

generation
bloom
abundant
grains
hatch
burrowing
masses
cases

GETTING READY TO READ

Draw a line under the right answer or fill in the blank.

1. When a plant grows flowers it is said to be in
   bloom *hatch* *leaf*
2. A new group of young born is called a
   animal *plant* *generation.*
3. It means a lot of something *bloom* *abundant* *hatch.*
4. To give birth to an animal in an egg is to
   hatch *bloom* *plant.*
5. If there is a lot of something they can be called
   blooms *masses* *hatches.*
6. When an animal digs into the sand or mud can be called _____.

SPRING AT THE SHORE

In spring, trees grow new leaves, flowers begin to bloom, and the grass turns green again. It seems as if the whole world wakes up, stretches and smiles. At the beach, the plants and animals feel the warming sun and the longer days and they begin to grow faster and to get ready to "give birth" to a new generation.

At the beach in spring, the cold and winds of winter are past and the long summer of warm days and abundant food lie ahead, so it is a good time for young animals of every kind to get a start in the world. If you look carefully on the beach during April or May you will find many kinds of eggs and tiny, new plants and animals. You may see millions of barnacles no bigger than pencil dots covering the rocks. Many female crabs will be carrying masses of eggs on the underside of their bodies. If you look closely at the eggs, you will see the eyes of the new crabs that are almost ready to hatch. Snails will be laying their eggs in cases of many sizes and shapes, some looking like grains of corn or oats, others like collars of sand. Many fishes lay their eggs on rocks or seaweed, but others burrow into the sand and stay there to guard the eggs they lay.

TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. In the spring the world seems to _____ up.

2. From this story you can tell that

   a. most young are born in the spring.

   b. the spring is a bad time to be born.

   c. winter is the best time to be born.

3. The story as a whole is about

   a. crabs.

   b. what happens at the beach in the spring.

   c. snails

4. All animals protect their eggs. Yes No Does not say

5. Barnacles can be very small. Yes No Does not say

6. What word in the last paragraph, last sentence means to protect?

   _____

SAY & KNOW

strain

covered

bivalve

hunting

siphon

feed

anchor

microscope

GETTING READY TO READ

Draw a line under the right answer or fill in the blank.

1. Animals with two shells are

   byssals *bivalves* *siphons.*

2. People can look at small things through a

   microscope *bivalve* *anchor.*

3. To hold something in place you can use an

   anchor *other* *animal.*

4. To eat is to *gland* *feed* *anchor.*

5. To take food out of the water is to

   thread *anchor* *strain.*

6. When you go looking for food you are _____.

MUSSELS AND HOW THEY FEED

Mussels are one of the very common animals on rocky Alaskan shores. They are bivalves. That means that their soft bodies are protected by a hard shell that has two parts, or valves, to it. Mussels live on rocks or on other hard places. They hold themselves there by using a gland in the foot to put down strong threads called byssal threads. The byssal threads anchor them to the rock, but the mussel breaks loose and move to another place if it needs to do so.

Mussels are filter feeders. That means that the food they eat is the very small plants and animals that drift in the water but that are almost too small for us to see without a microscope. When a mussel is covered by the sea, it opens its shell just a crack and begins to feed. It feeds by pulling water into itself through one opening, or siphon. Small plants and animals that are in the water going into the mussel are strained out, then the water is pushed out a second opening, or siphon. So a mussel never has to go hunting for its food. It just opens its shell and takes food from the seawater!

TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. Mussels have soft bodies protected by hard _____.

2. From the story you can tell that the mussel has

   a. 2 shells. c. no shell.

   b. 1 shell.

3. The story as a whole is about

   a. seaweed. c. byssus.

   b. mussels and how they eat.

4. Mussels eat things that are very big. Yes No Does not say

5. Mussels live on rocks and other hard areas. Yes No Does not say

6. What word in the first paragraph, second sentence means shells?

   _____

SAY & KNOW

mussel

insert

patient

wrap

gape

muscles

weaken

relax

GETTING READY TO READ

Draw a line under the right answer or fill in the blank.

1. If you can wait for something, you are

   patient weak soft.

2. To open wide is to *pull gape wrap.*

3. It means to put into *patient gape insert.*

4. To make weak is to *relax weaken fatten.*

5. The things in your body that help you move are

   muscles mussels stomach.

6. Before you give someone a present you _____ it.

HOW A STARFISH CAN EAT A MUSSEL

A mussel has a hard shell that it can shut very tightly, but a patient starfish can open the shell and eat the soft animal that lives inside.

If a starfish finds a mussel to eat, it wraps itself around the purple or brown shell and begins to pull with its tube feet. It may take several hours or even days, but the starfish just holds on and waits. Finally, the muscles of the mussel weaken and relax. Then the mussel's shell gapes open and the starfish can begin to feed. The starfish may push its stomach out its own mouth and insert it into the shell of the mussel. If it does that, then the starfish can eat the mussel in its own shell instead of pulling it out and swallowing it whole!

TESTING YOURSELF

Draw a line under the right answer or fill in the blank.

1. A mussel has a shell that is very _____.

2. From the story you can tell that

   a. some starfish eat mussels.

   b. mussels like to eat starfish.

   c. mussels have no shell.

3. The story as a whole is about

   a. a mussel's mouth.

   b. dinner for a starfish.

   c. purple and brown shells.

4. People eat mussels. Yes No Does not say

5. Starfish have tube feet. Yes No Does not say

6. What word in the first paragraph, first sentence means to close?

   _____

ANSWERS

Page 1 BEACH ZONES

Testing Yourself-

1. survive
2. b
3. c
4. yes
5. yes
6. adapt

Getting Ready to Read-

1. crevice
2. solid
3. swollen
4. feed
5. clinging
6. described

Page 2 ZONES ON ROCKY SEASHORE

Testing Yourself-

1. hide
2. a
3. a
4. no
5. yes
6. different

Getting Ready to Read-

1. surrounded
2. shallow
3. pigment
4. grouped
5. algae

Page 3 SEAWEEDS

Testing Yourself-

1. seaweed
2. a
3. b
4. yes
5. no or does not say
6. survive

Getting Ready to Read-

1. rockweed
2. zones
3. squeeze
4. disc
5. stormy

Page 4 ROCKWEED

Testing Yourself-

1. pigment
2. a
3. common
4. fasten
5. b
6. tips

Getting Ready to Read-

1. imagine
2. scarry
3. struggle
4. upper
5. discover
6. edge

Page 5 BEDROCK, BOULDERS OR MUD

Testing Yourself-

1. places
2. a
3. b
4. yes
5. yes
6. protection

Getting Ready to Read-

1. bloom
2. generation
3. abundant
4. hatch
5. masses
6. burrowing

Page 6 SPRING AT THE SHORE

Testing Yourself

1. wake
2. a
3. b
4. does not say
5. yes
6. guard

Getting Ready to Read-

1. bivalves
2. microscope
3. anchor
4. feed
5. strain
6. hunting

cont'd - ANSWERS

Page 7 MUSSELS AND HOW THEY FEED

Testing Yourself-

1. shells
2. a
3. b
4. no
5. yes
6. valves

Getting Ready to Read-

1. patient
2. gape
3. insert
4. weaken
5. muscles
6. wrap

Page 8 HOW A STARFISH CAN EAT AT MUSSEL

Testing Yourself-

1. hard
2. a
3. b
4. does not say
5. yes
6. shut

STEPS TO ORGANIZING A SEA WEEK IN YOUR COMMUNITY

I. Familiarize yourself with the Sea Week curriculum and introduce it to other interested teachers and parents.

II. Catalog the resources in your area. Where are the good beaches? When are the good low tides? Are there any agency, hatchery, or museum personnel that would be available as speakers and/or for field trips?

III. Draw up a well-thought out plan for Sea Week and present it to your administrators for approval.

IV. Talk to teachers in the upper grades about having some of their students accompany you on your field trips. Brief them ahead of time as to the activities you'll be doing.

V. Make up a calendar of when speakers will talk, which movies will be shown, and when each class will take their field trips. By arranging two field trips near one another in location, or by having the second class come to the beach when the first field trip of the day is leaving, gas (and energy) can be saved by having fewer bus trips.

VI. Invite the whole community to participate - parents, chamber of commerce, governmental agencies, native corporations, fishermen, etc. Parents can assist with field trips; businesses might display student artwork. If community organizations are interested, the week can become a Festival of the Sea, with boat tours, movies, speakers, games, and dances. Contact your local paper about featuring Sea Week with a photo and story - beforehand, during, and afterwards! Radio stations might want to interview field trip leaders - or read stories that students have written.

VII. Spend an entire week studying the amazing ocean! Math problems, writing assignments, spelling words - can all relate to our marine environment. Show your students the wonder of sea life!

Appendix II

SUGGESTED FIELD TRIPS

In planning field trips for your class two things should be considered: 1. The emphasis in Sea Week studies at your grade level. 2. The available community resources.

Consider visiting a place - beaches, docks, vessels (fishing, pleasure, ferry, barge, tour ship, Coast Guard), cold storage plant, canneries, supermarket, government research facilities, hatcheries. Museums, private collections and stores might be considered for indoor trips. Arrangements might be made to watch someone at work - fisherman, biologist, or Coast Guard personnel. If your students have an opportunity to visit another community you might include Sea Week activities in your itinerary or might include the entire trip around them.

In planning any trip, if possible arrange for knowledgeable persons to accompany your group. The involvement of interested parents is also valuable.

THIRD GRADE

I. Beach - trip activities are outlined in each section of the guide. Several trips to the beach could be well spent at this grade level.

II. Glacier - A field trip led by a knowledgeable agency or individual. A suggested lesson plan is in the guide.

WHAT TO DO ON THE BUS

Put together a checklist of objects (or use the one that follows) that the students may see at the beach. During the bus ride, students can circle the name (or picture) of each object that they think they will be seeing during the field trip. At the beach, they can check off the objects they actually saw, and estimate or count how many they saw. A Juneau teacher makes her checklists into a small book, with a pencil attached by yarn, and gives each pupil a sandwich bag in which to store his/her checklist.

bus	_____	cow	_____
can	_____	raven	_____
fish	_____	sheep	_____
tree	_____	driftwood	_____
gull	_____	boat	_____
buoy	_____	moose	_____
anemone	_____	dock	_____
whale	_____	starfish	_____
seaweed	_____	house	_____
crab	_____	airplane	_____
bottle	_____	fisherman	_____
jellyfish	_____	limpet shell	_____
sand flea	_____	sea urchin	_____
mussel	_____	porpoise	_____

Appendix IV

CONSERVATION

Conservation may be defined as the "wise use" of our natural resources. It is not the non-use of them, but rather a use that comes after careful thought has been given to the reasons and consequences of that use.

It is perhaps trite to say that with increasing population pressures, the ever-increasing need for raw materials, for recreational facilities, for homesites, etc., pressures increase on a natural environment that may previously have been untrammeled and in no need of someone to protect it from total alteration. Here in Alaska, particularily, the residents of the State are faced with making many immediate far-reaching decisions about the natural environment of our State. What man's impact on it will be and if and how that impact should be limited or controlled are some of these decisions.

Conservation, practically, comes down to a few important principles:

1. Every living thing, as well as non-living thing, has a place and function in the balance of existence on the surface of this planet, whether or not we happen to know what its precise niche is. "Everything is connected with everything else." "Everything affects everything else." Destruction of one species, useless and unimportant though that species may seem to our ignorance, can have wide-reaching repercussions.

2. Natural resources are exhaustible. Populations which drop below a critical threshold cease to reproduce and the species plummets into extinction. Energy resources on earth are not renewable. Extinction of living species and exhaustion of non-living resources are natural processes. Trilobites went extinct before men appeared on the scene. Volcanoes spew noxious gases into the air. Nevertheless, the speed with which man, especially 20th century man, is destroying or using up extant life and resources is astronomical compared to natural processes.

3. Since man is an intelligent being, he can, if he will, desist from extinguishing life and exhausting the resources of the earth. Man can practice conservation without denying himself a full and enjoyable life. His reason for using resources wisely may be an idealistic appreciation of all that nature has and is, or it may be a realization that our tomorrows will be poorer unless wisdom regulates usage of our goods.[1]

For school children studying Alaska's marine life, conservation involves a few simple, yet extremely important principals:

1. DO VISIT THE BEACH AND ENJOY YOUR TIME THERE BUT WHEN YOU LEAVE, LET THE AREA BE THE SAME, OR BETTER, THAN YOU FOUND IT.

2. IF YOU TURN OVER A ROCK TO SEE WHAT IS HIDING UNDER IT, TURN IT BACK OVER WHEN YOU HAVE FINISHED. (What lives there may depend for survival on the exact kind of micro-habitat that exists under that rock.)

[1] Reef and Shore. Hawaii Nature Study Program for Elementary School Children, p. 4.

3. IF YOU PICK UP ANIMALS FOR CLOSER VIEWING, DISTURB ONLY THE ONES YOU WANT TO LOOK AT, HANDLE THEM CAREFULLY, THEN REPLACE THEM WHERE YOU FOUND THEM. SEA CREATURES CAN LIVE OUTSIDE OF THE WATER ONLY BRIEFLY. A PAN OR BUCKET OF SEAWATER WILL ALLOW CLOSER EXAMINATION AND REDUCE STRESS ON THE ANIMAL. KEEP THE CONTAINER OUT CF DIRECT SUNLIGHT AND REPLACE THE WATER IF IT BEGINS TO WARM. HANDLE FISH WITH WET HANDS TO PRESERVE THEIR PROTECTIVE SLIME AND IN HANDLING CRABS AND JELLYFISH - WATCH OUT FOR STINGERS AND PINCHERS. PICK CRABS UP FROM THE BACK AND SUPPORT THEIR UNDERSIDE WITH THE PALM OF YOUR HAND. DON'T TOUCH JELLYFISH.

4. IF YOU WANT TO USE LIVE MATERIALS IN THE CLASSROOM AFTER THE FIELD TRIP TO THE BEACH, TAKE ONLY WHAT YOU WILL NEED, TAKE CARE TO KEEP IT ALIVE, AND RETURN IT TO THE BEACH WHEN YOU ARE FINISHED WITH IT.

5. NON-LIVING BEACH MATERIALS MAY BE COLLECTED BUT USE MODERATION HERE, TOO. IF MATERIALS ARE FOR CLASS USE, HAVE A PROJECT IN MIND BEFORE YOU BEGIN COLLECTING AND THEN GATHER ONLY WHAT YOU WILL NEED. YOU MAY WANT TO GATHER DRIFTWOOD, STONES, BITS OF POLISHED GLASS. UNLESS YOU ARE A SECOND GRADE TEACHER, HOWEVER, PLEASE COLLECT ONLY A FEW, IF ANY, EMPLY SHELLS LEAVING THESE MATERIALS FOR THE SECOND GRADERS WHOSE ONLY SEA WEEK BEACH AND CLASSROOM ACTIVITY IS STUDYING THEM.

Appendix V

A CHECK LIST

FOR

A FIELD TRIP TO THE BEACH

You the teacher:

1. Be sure you are personally familiar with the beach to which you and your class are going. If you have not been there before, take a bit of time after school or on the weekend to go to that beach and walk it carefully. By being familiar with it yourself, you can anticipate what your students will be able to see and do there.

2. Check carefully on all bus arrangements for your class. Be sure that a bus is scheduled for you and be aware of the delivery and pick-up times.

3. Arrange for adequate adult supervision. Usually there is no problem in finding parents willing to go along. Often junior or senior high school students may also be available and, if they are taking biology or other related science courses, they can be very helpful. One older student or adult for every five or six children would be a good ratio in terms of safety, control, and learning.

4. Give careful thought to what you will do with your time at the beach. The beach is an exciting place just to explore, but some thought and directions given to the activities to take place will make the experience richer and more profitable for students and you, too.

5. Meet - or at least talk by phone - with your volunteers before the field trip to acquaint them with your plans for the outing. Be sure that each of them knows specifically what you would like each to do. Recommend that they attend appropriate training workshops and provide them with information from this guide or elsewhere.

6. Well in advance of the beach trip itself, begin preparing your students for their experiences there. The better prepared they are, the more successful the field trip will be.

7. Letters should be written to all parents, including permission slips, so that parents know about the activities in which their children will be involved.

8. Collect and ready all materials you will need for the field trip - buckets, pans, binoculars, camera, whatever it is you need. You might consider bringing or arranging for some kind of snack at the beach - a big bag of gorp (M & M's, raisins, salted peanuts, etc.) always makes a hit and a snack can serve

to reorganize matters at the beach and create a natural (though slightly contrived) change of pace and focus. (see the suggested time plan that follows.) Be sure to take along a supply of bandaids - or better yet, a small first-aid kit - just in case there is a need for it.

9. Plan the trip ahead, but allow for flexibility. If a whale is breaching just off shore while you are trying to teach the life and ways of a barnacle, your students will not be absorbing much of your lecture. Be prepared to take advantage of those special events that occur so often along our shores.

The students:

1. Involve them in preparing for the field trip as much as possible.

2. Explain to them any rules for field trip conduct. Stress especially the fact that the beach is a special environment and a fragile one whose beauty comes from the LIVING plants and animals to be found there. Impress upon them the need to respect the life forms they will see, to leave the beach as nearly like they find it as possible and not to collect or molest live beach animals unless you, the teacher, have very specific and well thought out needs for limited quantities of live animals and materials for use in further teaching processes and have requested the students help you gather materials.

3. A quick talk about safety at the beach would not be out of place - the need for proper clothing, care to be taken on rocks that are slippery when wet, what to do in case of injury, always keep an eye on the tide to be sure you are not stranded or lose gear to the rising waters, etc.

4. If a class project is planned for the beach time, help students to prepare or gather materials they will need to take with them.

BOTH teacher and students:

BE PROPERLY DRESSED. It is always difficult to predict what the weather will be in coastal Alaska but there is often a good chance that there may be rain. Be sure everyone knows that he or she should come dressed warmly and prepared for rain if that prospect seems at all likely. Wearing layers of clothes always makes sense - a short sleeved shirt, then something with long sleeves, topped by a sweater or warm jacket and something water and wind-proof. Foot gear is important. Layer socks for maximum warmth and wear RUBBER boots if possible. Carrying a back pack is a good idea for students and teachers alike. It leaves your hands free, lets you store away layers of clothes you want to shed or don't need at the moment and is a good place to keep the snack you and/or the students have decided to bring along.

Appendix VI

SUGGESTED ON-SITE ORGANIZATION

The beach is an exciting place on your first visit there or your five hundredth and the most normal and natural thing to do on the beach is to walk - or run - along the shoreline to see what is there for the finding. If your class has been working hard on sea related studies and has carefully outlined what they want to do with their time at the beach, then perhaps all students will set right to work with whatever tasks have been outlined beforehand. But, if a less structured approach seems to be in order, you might try the following idea...

Part I

If, before the beach experience, you have been working in the classroom with the students on the particular area of marine knowledge outlined for your grade level, then the students should have a good idea of particular concepts or kinds of life or situations they might look for at the beach. Students could have the first half of the time at the beach to apply their knowledge in a free kind of framework. That is, for example, if you are a second grade teacher and have been studying shells with your students, give them the first part of their time at the beach to see how many different kinds of shells they can count, or give them some other similar kind of task that they can carry out and at the same time still be free to explore other aspects of the beach.

Part II

At the mid-point of your allotted time at the beach, gather the children together. Taking a bit of time out to open that big bag of gorp, or gathering for some other kind of snacking, works to draw everyone together, change the pace and focus.

After the quick energy break is a good time to have the students sit down quietly and talk about what they have seen or to have adult helpers work in small groups with children to share further discoveries or knowledge about materials found on the beach. As an example, if you are a first grade teacher who has been studying marine animals with your class, each adult helper might have been assigned to gather in a bucket - with the children's help - examples of a particular group of animals during the first part of the time on the beach. Then, during the second half of the beach time, each adult and his or her bucket of materials might circulate from one small group of children to the next, encouraging them to touch, feel, observe certain characteristics or qualities of these particular animals.

Children need both to enjoy the beach just for the pleasure there is in being there and to grow in understanding the complex web of life and environmental factors that are at work there. If careful thought and planning have gone on well before the actual trip to the beach, there is every reason to believe that both these goals can be accomplished.

A LOOK AT THE BEACH

Any beach is as individual in its own way as are we who, as individuals can be distinguished from all other people. Just as each of us represents only one combination out of the many possible, so it is with beaches. A beach is a place where the sea confronts the land, and every aspect of that sea and that land edge is important in determining what the general appearance of that beach will be and what kinds of plants and animals will grow and thrive in that particular environment. Many factors combine to determine the personality of that unique and special place.

The Sea

If we think first about the water at the beach, we realize that there are several ways in which it can vary. To begin with, for example, those of us living in the Juneau area look out to waters that are relatively protected. That is, our beaches are not subjected to the open, powerful swells that are common on coast lines that abut the open ocean. Unlike conditions that might be found at Sitka, for example, the wave conditions along our beaches are always relatively mild and non-violent. Even in the Juneau area, however, local differences in topography influence the personality of the beach. Whether a particular beach area is a straight, uninterrupted stretch, a deep or shallow cover, or a jutting point will influence the force and effect of the waves upon the shore. Consequently, we might expect to find different kinds of life on a point, in a cove, or on a straight, uncomplicated shoreline because each species has a particular ability to withstand greater or lesser wave force.

We all know that the sea is salty but we may not all realize that the concentration of salt in sea water can be highly variable. In the open ocean, salt concentrations measure about 32 to 33 parts per thousand. In our inside waters around Juneau, the average salt concentration in main channels may be slightly less than that because of the greater influence of fresh water entering from streams and rivers. At the mouths of the streams and rivers themselves, where salt and freshwater mix, salt concentrations are very low. Because each kind of marine plant or animal has its own built-in tolerances to varying saltiness or freshness, these living populations vary with the salinity prevalent at a particular place.

THE SIZE OF PEBBLES

If you stand on a beach and look thoughtfully at it, one of the first things you will notice is its texture - whether it it sandy, gravelly, composed of cobbles, bedrock, mud or a combination of two or more of these. The nature of the beach is critical in determining what can live there. Let's examine each kind of substrate in turn to see what kind of life we might expect to find.

Mud

Mud can be anything from relatively porous sand-soil mix to the clay muck that sucks rubber boots right off your feet. If you look at the surface of this kind of substrate, you will be aware of little, if any, life. Here and there you may see the flexible tubes of mud dwelling worms sticking up an inch or so above the surface. Or you may see "cake decorations" left by other burrowing worms. Finally, you may be aware of the presence of clams by the squirts of water and the siphon holes in the mud. Digging with a shovel will reveal the various inhabitants of the mud in all their glory - fat, bulbous peanut worms: slender, earthworm-like nemerteans of various descriptions; many-legged annelid worms; and hardy bivalves.

Sand

Because sand is more porous than mud, it is a better surface for many burrowers, a better surface for a wider number of animals to live on and in. On a sand flat at low tide one may find starfish, sea urchins, and numerous kinds of crabs and snails. Some of these animals wander over the sand flats when they are submerged, scouring them for bits of food. Some crabs, like the Dungeness, tend to stay in sandy areas because of the methods of self-protection involves burrowing into the sand to hide. (Even when the sand is exposed, watch for depressions in the surface that mimic the shape of the crab's shell. By digging there, you may uncover a crab that stayed buried even as the water receded.) By looking for clam or cockle siphon holes, you will discover these common residents of sandy areas and by digging carefully you may unearth them.

Cobbles and Boulders

Obviously, the size of loose rocks on the beach may range from something just a bit coarser than sand up to boulders too large to be lifted. In general, the larger the general size of the rock pieces, the greater variety of life one might expect to find there. The more stable the hard surface is, the greater protection and anchors it can afford a resident plant or animal. Intertidal areas of cobbles or rocks are often most obviously serving as anchorages for marine plants (most common in the Juneau area, Fucus, the rockweed, the tough, ubiquitous, brown plant with the bulbous reproductive bodies that kids like to pop) and for barnacles and blue mussels that may cover certain rocks of sections of beach in great density. If you begin to look down among the beds of rockweed, barnacles, and mussels and UNDER cobbles and boulders, you will discover an amazing diversity of life forms. Small six-rayed starfish cling beneath medium sized rocks, often brooding clutches of eggs. Blennies up to six inches or so in lenth (one of the two most common intertidally discovered fish) hide under rocks. So do amphipods or sand fleas and tiny crustacean beach scavengers that quickly seek new cover when discovered under their protective rock. Clinging to the surface of the rocks may be limpets, chitons, sponges. Look for the latter particularly under overhangs of larger rocks.

Because of their ability to serve as anchors and because they offer so many protective niches, rocks on beaches afford some to the best looking places. Don't neglect to have along a magnifying glass so you can really see some of the tiny critters! Guaranteed that the more your look, the more you will see there! Just be very sure that after you turn over a rock to reveal its underside residents, that you replace it so the animals don't dry out and perish.

Bedrock

This is just as exciting a place to poke as cobbles/boulder areas and many of the same inhabitants can be found here - with two general kinds of exceptions. First, obviously this rock surface can't be turned over so the "rock and sand or mud residents" are not here. Second, it is in bedrock areas that you are most apt to find remnant puddles of water - tidepools - that may harbor lots of life, including small anemones with tentacles extended to trap food (they come in a wide variety of gorgeous color combinations), rock hard coralline algae that looks like hard, pink plaster but are actually living plants, tiny immature sculpins, and perhaps little shrimp. Be sure to look carefully in crevasses for sponges, starfish, and other creatures.

THE DISTANCE FROM THE WATER

Each species of marine plant and animal has a particular tolerance to being out of salt water. Some of them, for example, are never found intertidally because they have absolutely no tolerance for exposure to the effects of an air environment. Others can stand being out of salt water for extended periods of time, needing only to be wet by the sea on occasional very high tides. By looking at the beach in a section from its highest high water mark down to the water level on a low, low tide, you can quickly begin to see major differences in plant and animal populations.

The Highest Fringe

At the upper limits of the intertidal zone, least life forms are evident. You may notice that the rocks appear black here. This is because they are covered by a black encrusting lichen or by a blue-green algae that makes these rocks treacherous and slippery when wet. In these upper reaches, too, may be found the common tiny periwinkle - a fat, ridged snail that sometimes seems to pepper the rocks.

The Middle Zone

As you move down toward the water's edge on a low tide, you will be aware of obvious color bands or patches on the beach. There may be banding of Fucus, the common brown rockweed, and of blue-black mussels (the intertidal - and subtidal - bivalve that attaches itself by tiny threads to rocks and pilings and other surfaces), and barnacles. Here too you will begin to see limpets (the species of which are sometimes most quickly identified by how low or high they are found on the beach) amphipods, various starfish, tiny black sea cucumbers, and other forms of life there were not in evidence at higher levels.

The Lowest Zone

As you approach the water's edge, you will not find some of the plants and animals that were evident at higher levels. In general, however, the lower you go in the intertidal zone the greater the diversity of life forms you will find. Here you will find sea urchins, a wide variety of often large starfish, perhaps juvenile king crabs, large white or varicolored sea anemones (if they are out ot water, these will look like squishy, uninviting blobs, but look out into the shallow waters to see the same animals in all their expanded glory), and the larger snails.

So...as you look at any particulat beach for the first time, there is a great deal to think about. Remember that each part of the beach, each kind of surface type, each height from the water, each kind of topographical variation indicates what life may be found there. In general, it is advisable to spend the lowest part of the tidal cycle closest to the water's edge for in that way you will have the maximum amount of time to spend along the beach area that is revealed to us least often and which tends to harbor the greatest diversity of plants and animals.

If you can, acquaint your students with these obvious or subtle variations in the beach habitat for it will enrich their beach experience, too!!!

TIDES

Students can understand some basics about tides and should definitely learn that the height of the water on the beach varies with the stage of the tide and that maximum and minimum tidal levels vary each day.

Tides, in a very simplified kind of explanation, occur because of the gravitational pull of the sun and the moon on the earth. Just as the earth exerts gravitational force (why does an apple fall? why can't we step off into space?), so do these other two bodies. The force of the pull of the sun and moon on a particular place on earth depends on how directly they are in line with that place. The force they exert tends to pull the water away from the earth's surface on the side of the earth facing,thus causing a high tide. Because the relative position of the sun, earth, and moon are constantly changing in a cyclic rhythm, so are the tides.

Activities

Here in Southeast Alaska we experience a tidal cycle that consists of two unequal high tides and two unequal low tides each day. With some students in primary grades and all those in upper grades, you might sit down with a tide table and look at the numbers and explain what they mean. You might even make a simple chart of tide levels and of activities to coincide with various stages of the tide. For instance, it might be much easier to launch a boat when the tide is high but digging clams can best be done on the very lowest tide. Students might be shown the same beach at high and at low tide and through words or art work compare the differences.

Preparation for Field Trip

In preparing for the field trip, discuss tides with the students. Mention the need to be as close to the water as possible when the tide is at its lowest in order to see that strip of beach and the life that is there, for the water quickly comes in and covers it. Talk, too, about the need to be aware of the tide level and thus not to set a pack or bucket next to the water's edge and expect to find it there later if the tide is flooding.

As a teacher you need to be aware of the time of low tide when scheduling your field trip to the beach and in planning the activities that will take place there. The time of very lowest tide should be kept open for observation of what is to be found in the zone nearest the water. Activities such as taking a break for a snack or gathering around buckets to discuss and examine particular animals should occur when the tide is ebbing or flooding.

Appendix IX

A BIBLIOGRAPHY OF HELPFUL REFERENCES

Field Guides

Abbott, R. T. 1968. *Seashells of North America.* Golden Press, New York. 280 pp. $3.95.

Ayres, J. and D. McLachlan. 1979. *Fieldbook of Pacific Northwest Sea Creatures.* Naturegraph Publishers, Inc. Happy Camp, California. 208 pp. $10.00.

Furlong, M. and V. Pill. 1973. *Edible? Incredible!* ERCO, Inc., Tacoma, Washington. 62 pp. $2.50.

_____. 1973. *Starfish - Guides to Identification and Methods of Preserving.* ERCO, Inc., Tacoma, Washington. 104 pp. $3.50.

Guberlet, M. L. 1956. *Seaweeds at Ebb Tide.* University of Washington Press, Seattle. 182 pp. $4.95.

Hosie, R. C. 1969. *Native Trees of Canada.* Information Canada, Ottowa. 380 pp. $7.20.

Kozloff, E. N. 1974. *Keys to the Marine Invertebrates of Puget Sound, the San Juan Archipelago and Adjacent Regions.* University of Washington Press, Seattle. 266 pp.

Madlener, J. C. 1977. *The Seavegetable Book.* Clarkson N. Potter, Inc., New York. 288 pp. $6.95 (recipes!).

McClane, A. J. 1978. *Field Guide to Saltwater Fishes of North America.* Holt, Rinehart and Winston, New York. 283 pp.

Murie, Olaus J. 1975. *A Field Guide to Animal Tracks.* Moughton Miffin Co., Boston. 375 pp. $6.95.

Murray, C. and D. Somerton. 1976. *Field Guide to the Fish of Puget Sound and the Northwest Coast* (printed on waterproof paper). University of Washington Press, Seattle. 70 pp. $5.95.

Rice, T. 1973. *Marine Shells of the Pacific Coast.* ERCO, Inc., Tacoma, Washington. 102 pp. $2.95.

Robbins, C. S., B. Bruun, and M. S. Zim. 1966. *Birds of North America.* Golden Press, New York. 340 pp. $4.95.

Smith, L. S. 1976. *Living Shores of the Pacific Northwest.* Pacific Search Press, Seattle. 149 pp. $9.95.

Viereck, L. A. 1974. *Guide to Alaska Trees.* United States Forest Service, Washington, D. C. 98 pp. $1.35.

Waaland, J. R. 1977. *Common Seaweeds of the Pacific Coast.* Pacific Search Press, Seattle, Washington. 120 pp. $5.95.

Marine Mammals

Graves, J. A. 1977. *What is a California Sea Otter?* Boxwood Press, Pacific Grove, California. 30 pp. $3.50.

McDearmon. 1974. *The Walrus - Giant of the Arctic Ice.* Dodd, Mead, and Co., New York. 45 pp. $4.25.

Proctor, S. J. 1975. *Whales - Their Story.* Vancouver Public Aquarium Association Newsletter vol. XIX no. 4, July/ August 1975. Vancouver, British Columbia, Canada. 14 pp.

Slijper, E. J. 1976. *Whales & Dolphins.* The University of Michigan Press. 170 pp.

Stonehouse, B. 1976. *A Closer Look at Whales and Dolphins.* Gloucester Press, New York. 31 pp. $1.95.

Fish

Burton, Dr. M. 1972. *The Life of Fishes.* Golden Press, New York. 61 pp. $2.95.

Childerhose, R. J. and M. Trim. 1979. *Pacific Salmon.* University of Washington Press, Seattle. 158 pp. $24.95.

DeCarli, F. 1978. *The World of Fish.* Abbeville Press, New York. 256 pp. $6.95.

Hart, J. L. 1973. *Pacific Fishes of Canada.* Fisheries Research Board of Canada, Ottowa. 740 pp. $14.40.

Birds

Bradbury, W. 1976. *Birds of Sea, Shore, and Stream.* Time Life Films, Inc. 128 pp. $8.95.

Ecology

Adams, R. 1978. *Nature Day and Night.* Viking Press. New York. 107 pp. $10.00.

British Museum of Natural History. 1978. *Nature at Work.* British Museum, London. 84 pp. $4.95.

Carefoot, T. 1977. *Pacific Seashores.* University of Washington Press, Seattle. 208 pp. $14.80.

Activities

Cornell, J. B. 1979. *Sharing Nature With Children.* Ananda Publications. 142 pp. $4.95.

Curriculum Research and Development Group - University of Hawaii. 1976. *Reef and Shore - Hawaii Nature Study Program for Elementary School Children, Teachers' Guide.* University of Hawaii, Honolulu. 265 pp.

Lien, V. 1979. *Investigating the Marine Environment and Its Resources.* Sea Grant College Publications, Texas A and M University, College Station, Texas 17843. 439 pp. $8.00

Mauldin, L. and D. Frankenberg. 1978. *North Carolina Marine Education Manual* (4 volumes). UNC Sea Grant Publication UNC-56-78-14-A, North Carolina State Univesity, Raleigh, North Carolina 27607.

Oceanography

Bascom, W. 1964. *Waves and Beaches: the Dynamics of the Ocean Surface.* Doubleday and Company, Inc., Garden City, New York. 267 pp. $2.50.

Scientific American. 1969. *The Ocean.* W. H. Freeman and Company. 140 pp. $3.25.

Issues

Ball, J. L. Jr., T. Frady, and R. S. Lee (eds). 1977. *Readings From Alaska Seas and Coasts.* Alaska Sea Grant Program, Fairbanks. 252 pp.

Browning, R. J. 1974. *Fisheries of the North Pacific: History, Species, Gear, and Processes.* Alaska Northwest Publishing Company. Anchorage. 408 pp. $24.95.

Drucker, P. 1963. *Cultures of the North Pacific Coast.* Chandler Publishing Company, Scranton, Pennsylvania 243 pp.

Figdor, B. and G. 1978. *Salmon Fishing* (one of a children's series of people at work in Alaska). George Figdor, Haines, Alaska. 48 pp. $7.95.

Kramer, L. S., V. C. Clark, and G. J. Cannelos. 1978. *Planning for Offshore Oil Development: Gulf of Alaska OCS Handbook.* Alaska Department of Community and Regional Affairs, Division of Community Planning, Juneau. 257 pp.

Miscellaneous and General References

Alaska Dept. of Fish and Game. *Wildlife Notebook Series. (fish species and crabs)* Juneau.

Angel, H. 1976. *Life in the Oceans.* Cathay Books, London. 125 pp. $6.66.

Angel, T. and Harris. 1977. *Animals of the Oceans.* Two Continents Publishing Group, New York. 156 pp. $10.95.

Berrill, N. J. 1966. *The Life of the Ocean.* McGraw-Hill Book Company, New York. 232 pp. $7.50.

Calvin, J. and E. Ricketts. 1968. *Between Pacific Tides.* Fourth Edition. Stanford University Press, California. 614 pp. $12.50

Flora, C. J. and E. Fairbanks, M.D. 1977. *The Sound and the Sea: A Guide to Northwestern Neritic Invertebrate Zoology.* Washington State Dept. of Printing, Olympia. 474 pp. $8.50.

Johnson, M. E. and H. J. Snook. 1927. *Seashore Animals of the Pacific Coast.* McGraw-Hill, New York. 523 pp.

Tyler, J. 1976. *The Children's Book of the Seas.* Usborne Pub. Ltd., London. 32 pp. $2.95.

United States Forest Service. *Beach Camping* and other informative publications. Juneau.

University of Alaska. Alaska Sea Grant Program. *Alaska Tidelines,* a Sea Grant Publication for Alaska Schools. Fairbanks.

Plus +++ check with agencies in your area, aquaculture associations, the U. S. Coast Guard, local corporations to see what publications they may have available.

OTHER LEARNING AIDS

The Alaska State Museum has multi-media learning kits available for use by Alaskan schools, including a Salmon kit. Priority use is given to bush schools. Write: Alaska State Museum, Pouch FM, Juneau, Alaska 99811.

Your school can order films through the Alaska State Film Library. Their marine science/oceanography listings are too numerous to mention, but some topics that are dealt with include: marine invertebrates, ocean currents, the beach, whales, life cycle of the salmon, mollusks, tide pool life, marine science careers, sea birds, octopus, the ocean as a food source, fishing techniques, the ecology of the ocean, and seacoast cultures.

The Smithsonian Institution is currently field testing a binder of estuary study activities ($9.68). Activities include: Beachcombing, Mapping, Barnacles, Build A Trap, Fish Adaptations, Fish, Marsh Muck, Crabs, Water in Motion, Menance Oil Slick, Oil Spill Cleanup, and Estuary 3-D Board. For more information write:

SEA (Smithsonian Estuarine Activities)
Chesapeake Bay Center For Environmental Studies
Smithsonian Institution
P. O. Box 28
Edgewater, Maryland 21037

Posters on beach safety and pamphlets on tides, whales, crabs, and other marine topics are available from the Oregon State University Sea Grant Marine Advisory Program. For a catalog and price list (many are free) write:

Extension Communication-Marine Advisory Program
Oregon State University AdS 422
Corvallis, OR 97331

ALASKA SEA WEEK EVALUATION FORM

computer code numbers

1. Town or village_____ (1-4) (5)

2. Grade level_____ (6-7)

3. Number of students involved_____ (8-10)

You may need to review your Alaska Sea Week materials to answer these questions.

4. How many classroom (indoor) activities and worksheets did you use from each book?

Book (Grade level)	Number of activities	
Discovery (K)	_____	(11-12)
Sea Animals (1)	_____	(13-14)
Shells (2)	_____	(15-16)
Glacial & Intertidal Ecology (3)	_____	(17-18)
Birds (4)	_____	(19-20)
Fish (5)	_____	(21-22)
Man's Influence on the Sea (6)	_____	(23-24)

5. What is the total number of field (outdoor) activities used from the 7 books?____ (25-26)

6. How many periods (1 hr. each) did your class spend on the Sea Week Program?_____ (27-29)

Please check the appropriate box to the right of each question.

	decidedly yes	yes	no opinion	no	decidedly no	
7. Were the Alaska Sea Week materials relevant to your curriculum?	___(1)	___(2)	___(3)	___(4)	___(5)	(30)
8. Did the Sea Week materials motivate students to improve their math, reading, & writing skills?	___(1)	___(2)	___(3)	___(4)	___(5)	(31)
9. Did the Sea Week materials upgrade your science program?	___(1)	___(2)	___(3)	___(4)	___(5)	(32)
10. Did students enjoy the Sea Week activities?	___(1)	___(2)	___(3)	___(4)	___(5)	(33)
11. Did students develop a greater awareness, appreciation, and respect for the sea?	___(1)	___(2)	___(3)	___(4)	___(5)	(34)
12. Did students develop decision-making skills necessary for resolution of marine issues?	___(1)	___(2)	___(3)	___(4)	___(5)	(35)
13. Was the material appropriate for your students' grade level?	___(1)	___(2)	___(3)	___(4)	___(5)	(36)
14. Was the teacher background section adequate?	___(1)	___(2)	___(3)	___(4)	___(5)	(37)
15. Were the teacher instructions helpful & complete?	___(1)	___(2)	___(3)	___(4)	___(5)	(38)
16. Were parents and other community members involved in your Sea Week?	___(1)	___(2)	___(3)	___(4)	___(5)	(39)
17. Were parents favorably impressed with the Sea Week Program?	___(1)	___(2)	___(3)	___(4)	___(5)	(40)
18. Did Sea Week help improve the relationship of the school to the community?	___(1)	___(2)	___(3)	___(4)	___(5)	(41)

19. Rate your overall feelings about the Sea Week MATERIALS on a scale of 1 to 5._____ (42)
(1=high; 5=low)

20. Rate your overall feelings about the Sea Week PROGRAM on a scale of 1 to 5._____ (43)
(1=high; 5=low)

(OVER, PLEASE)

21. How many teachers are in your school? _____
How many are using Sea Week materials? _____ (44-45)

22. Do you plan to introduce the Sea Week materials to other teachers? yes____(1)
no____(2) (46)

23. Do you plan to use the Sea Week materials aga_n? yes____(1) no____(2) (47)

24. Would you be interested in attending a marine education/Sea Week workshop?
yes____(1) no____(2) (48)

If so, list your name and school address:

Name _____

Address _____

25. What other comments do you have? Are there any specific improvements you would suggest?

Please return this completed form to Jill Thayer/Belle Mickelson, Alaska Sea Grant Program, University of Alaska, Fairbanks, Alaska 99701.